Appendix A
Public and Agency Coordination

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Habitat Restoration Plan (Fact Sheet)

Edward (Ted) and Pat Jones – Confluence Point State Park

Missouri River

Fish and Wildlife Mitigation Project

1. Site - The Edward (Ted) and Pat Jones – Confluence Point State Park (Confluence Point) is a 1,118-acre property consisting of two sections. The 532-acre section in the north was initially acquired by the Confluence Greenway. These acres were purchased by the U.S. Army Corps of Engineers (Corps) from the Confluence Greenway in 2007 and remain in Corps ownership. Missouri Department of Natural Resources (MDNR) is the primary partner for this project and owns the remaining balance of project lands. MDNR has responsibility for long-term management of the property.

2. Location - Confluence Point State Park is located at the eastern tip of St. Charles County, Missouri and spans the distance between the main channels of the Missouri and Mississippi Rivers at their junction. Its terrain is characterized by a mild hill and swale topography that shows a pattern of flooding and drainage that generally flows from west to east. Total relief is approximately twelve feet with elevations ranging from 408 to 421 feet above sea level. A natural levee has developed along the Missouri River, and two other isolated terraces or high spots are situated internally. Much of the soil on Confluence Point formed from recent alluvial deposits that accumulated after the Missouri River Bank Stabilization and Navigation Project (BSNP) altered the area for navigation. They are low in elevation and are frequently flooded with ground water that fluctuates with river levels.

3. Resource Problem - Prior to construction of the BSNP, the lower Missouri River was uncontrolled and meandered across a wide floodplain creating a highly dynamic environment through the physical processes of erosion, deposition, and accretion. The historical lower Missouri River consisted of numerous islands, channels, sandbars, and slack water. At the time of the Lewis and Clark Expedition, the confluence was 2 miles upstream from its current position. Prior to the BSNP, the southern portion of the project area was in the Missouri River channel. After the BSNP, the confluence area was stabilized and the project area took its current shape. The land that now composes the southern portion of the Confluence Point Site was accreted from recent alluvial sediment. The Confluence Point Site was covered with trees and was not cleared for farming until the 1950s.

The Kuhs levee was built in the 1960s and is maintained as a five-year flood protection levee by the Kuhs levee sub-district of the Consolidated North County Levee District. The levee surrounds the property alongside both rivers, and except for three gated pipes or when the levee is breached by flooding, there is no direct connectivity between the

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park and Mississippi or Missouri Rivers. The top of this levee is at 426 feet. The banks of the rivers themselves are very steep and covered in many places by rip-rap. Channel control structures border the property, with mudflats exposed behind them at low river stages. Compared to upstream lands, this park has a low elevation relative to the normal level of the Missouri River.

4. Opportunity - The proposed project would develop fish and wildlife habitat at Confluence Point State Park. According to the MDNR's 2004 Revegetation Plan, the restoration vision for Confluence Point State Park is a natural floodplain. This vision emphasizes native vegetation and the natural wetlands suitable for the site's current soil, topography, and hydrology. It reflects the examples offered by Missouri Natural Areas and other old-growth natural ecosystems along the Missouri and Mississippi Rivers, yet recognizes the dynamic nature of floodplain ecosystems and the modern alterations of the rivers and their floodplains.

Missouri Department of Natural Resources has developed a detailed preliminary plan for restoring the Confluence Point site. The stated goal of the MDNR plan is:

> "To restore the natural communities and native vegetation of a frequently flooded low riverfront ecosystem. This will be a predominantly forested landscape that follows the hill and swale topography on the site, with seasonally flooded sloughs and marshes in the low swales and scour channels. It will include wet prairie bordered by groves of pin oaks. These vegetation types will be restored or facilitated according to the different wetland zones and soil types at the park."

MDNR identified five wetland zones that exist or could exist within the property. In the case of Confluence Point where minimal native vegetation remains, these wetland zones could potentially be used to predict the natural communities for which the flood patterns are best suited, and tie these to specific park elevations.

- Zone I wetlands are open water that is continuously flooded; a hydrology that currently only applies to the scour holes along the Mississippi side of the property.
- Zone II wetlands are intermittently exposed; flooded essentially every year for most of the growing season.
- Zone III wetlands have a hydrology described as semi-permanently flooded (51-100 % of years), with the total duration of flood events typically more than 25% of the growing season. Soils are dominated by clays, and a lack of oxygen prevails for much of the year.
- Zone IV wetlands are seasonally flooded (51-100% of years), for 12.5-25% of the growing season.
- Zone V wetlands are described as temporarily flooded (11-50% of years), for 2-12.5% of the growing season. Their soils are dominated by silt loams, silty clay loams and very fine sandy loams that are only briefly flooded and therefore much better suited for root respiration.

5. Proposed Project - The project would include the use of a combination of methods to develop fish and wildlife habitat on the Confluence Point Site. These methods would

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include planting of trees, prairie plants, and wetland vegetation in appropriate locations based on topography, hydrology, soils, and location of utilities (roads, power lines, and pipelines). The 2004 MDNR plan had to be altered to accommodate the numerous pipelines and power lines that cross the site. Small basins would be constructed to capture and hold water as ephemeral wetlands. Larger areas would be constructed to induce more permanent wetland habitat. These would be developed in a manner that would resemble naturally contoured systems. Figure 1 displays current conditions and Figure 2 displays proposed future conditions.

a) Revegetation efforts for the Full Development Alternative would include the following:
   - Wet-mesic bottomland forest: Establish a forest that includes a matrix of pecan and bur oak, with a complimentary mix of green ash, American elm, slippery elm, hackberry, sugarberry, pin oak, and swamp white oak. Shellbark hickory, persimmon, and Kentucky coffee tree might be planted on the highest elevations. Native Virginia wild rye will be sown as a cover crop.
   - High wet bottomland forest: Establish a forest that includes a matrix of pin oak and swamp white oak, with a complimentary mix of pecan, green ash, American elm, sycamore, and slippery elm. As with the wet-mesic forest plantings, sow Virginia wild rye as a cover crop.
   - Low wet bottomland forest: Promote natural regeneration of riverfront species such as cottonwood, willow, elm, ash, and silver maples on the more frequently flooded areas. The ground will be lightly disked prior to seed rain to capture the natural seed fall. No planting should be needed for these species.
   - Prairie: Establish prairie on the high plain in the northern portion of the park. Prairie may also be established along utility corridors that must be kept free of trees. If hydrology is suitable, these prairies are to be dominated by wet prairie species such as Virginia wild rye, big bluestem, cordgrass, indian grass, switchgrass, and white-scale sedge. Forbs such as false aster, swamp milkweed, sawtooth sunflower, prairie blazing star, compass plant, ironweed, and rattlesnake master will be planted where appropriate. Other appropriate mesic species may be included on high spots within the prairie. MDNR will manage the prairie areas through seasonal burning.
   - Scrub/Shrub Wetland: Scrub/shrub will be established in the upper perimeter of the natural basins and in depressions that hold water from rainfall or backwater flooding. Sedges and broadleaf plants would likely colonize naturally, but planting of buttonbush by seed or rootstock could be necessary. The distribution and extent of scrub/shrub wetland would be dictated by prevailing hydrology and would be allowed to develop naturally.
   - Sandbars, Mudflats, and Ephemeral wetlands: Natural topography exists on the site that could be prone to long-term inundation. It is hoped that these areas will recede slowly and continuously expose muddy shorelines. In some case the natural topography will be enhanced to maximize this type of habitat. These shorelines would be colonized by seasonal emergent vegetation. Artificial basins would also be developed throughout the site. These areas

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would be designed to only hold water for limited durations, which would support ephemeral wetland conditions.

b) Other vegetation management:
- Portions of the site will remain fallow in order to serve as planting sites in the future for environmental education purposes.
- Plant a 100' wide strip of wild rye around the perimeter of the property, and maintain by mowing until other forest or prairie plantings take place. This is to serve as a weed buffer against private agricultural land on the west boundary, and allow access and borrow areas for levee repair elsewhere.
- Control Johnson grass by mowing and herbicide application throughout the revegetation process.
- Unless specifically referenced, any plant species that is not native to the area and normal for the natural community will not be used in any of the restoration work. Preference will be given to obtaining native plant materials grown from locally obtained stock.

c) Excavations:
- Meanders: Shallow and deep meanders will be excavated on soils capable of supporting perched water. Both types will be ephemeral, with the deep meanders holding water slightly longer than the shallow. Excavations will be designed to replicate the appearance of natural floodplain swales. These areas will be located primarily in the northern prairie restoration area and will capture and hold precipitation, upland runoff, and occasionally river floodwater.
- Shallow Scours: several minor excavations coupled with low berms would enhance the hydrology of swales that naturally occur on the Confluence Point site. The berms would only be of sufficient height to induce surface water retention on a seasonal basis.
- Semi-permanent Pools: It is likely that natural floodwater would fill these basins during spring and early summer when groundwater and surface water are high due to river flooding. When the floodwaters recede, the basins would continue to hold water. As summer progresses, the water in the basin should continue to slowly recede and provide freshly exposed shoreline.

d) Long-term maintenance:
Maintenance of existing and newly created habitats would be performed through Cooperative Agreement with MDNR. Maintenance of the mitigation features constructed by this project will be 100% O&M funds.

e) Monitoring:
Monitoring of the habitat improvements will be conducted by MDNR and will be limited. Visual observation of the health of the vegetation will be conducted on an annual basis. Physical measurement of the amount of habitat and any changes over time, such as trees advancing to successional stage, will be conducted every 5 to 10 years. This monitoring effort is considered to be routine maintenance activity and will be paid for by Corps O&M funds. There is an effort to formalize

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an M&E plan for the mitigation program. As this plan is developed, monitoring of the project site may be adjusted to fit the goals and objectives as laid out by the M&E plan.

f) Adaptive management efforts may become necessary on the site if drought conditions persist or if flooding results in damage to project features or vegetative plantings. Additionally, the biotic response of restoration measures, results of the monitoring program, changing site conditions, and opportunities to focus on achieving the maximum restoration benefits possible at each site may also require changes to the site through adaptive management. In all likelihood, unknown and unpredictable factors related to sub-surface hydrology and long-term weather patterns will ultimately determine the final composition and arrangement of the site. All reasonable effort will be made to maximize the available habitat. If any re-work is needed to restore the area, it will be paid for using Corps CG funds.

6. PROJECT OUTPUTS

a. This project will result in increases in desirable habitats at the site and improved management of the area. Over time, modification to the existing topography will maximize desirable wetland habitat. Large chunks of valuable and scarce habitat such as prairie and ephemeral wetland will benefit many species migrating through the area. Changes through the Annual Management Plan process will result in enhanced prairie, wetlands, and forested areas that will benefit multiple species and help restore the Missouri River ecosystem.

b. Table 1 summarizes the acres of general habitat types that currently exist at the Confluence Point Site, the desired future acres of habitat that would result from implementation of the preferred alternative, and project outputs (net habitat changes).

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Table 1: Project Outputs

General Habitat Type	Existing Acres	Proposed Acres	Output[1]
Wet Prairie/Grassland	41.3	276.5	235.2
Boltonia Restoration	18.2	28.5	10.3
Sandbar/Mudflat	0	38.4	38.4
Scrub/Shrub	0	167.5	167.5
Wet Bottomland Forest (Low)	306.6[2]	126.2	-180.4[1]
Wet Bottomland Forest (High)	58.0[3]	100.7	42.7
Wet-Mesic Forest	0	60.0	60.0
Deep Meander	0	1.3	1.3
Deep Pool	0	53.0	53.0
Shallow Meander	0	8.2	8.2
Shallow Pool	0	50.7	50.7
Shallow Scour	0	3.6	3.6
Spoil Banks	0	12.5	12.5
Mounds	0	8.9	8.9
Crops/Agriculture	511.9	0	-511.9[1]
Existing 404 Wetland	11.2	11.2	0
Existing Bottomland Forest	88.5	88.5	0
Existing Scrub/Shrub	36.5	36.5	0
Levee	38.9	38.9	0
Existing Blew Hole	7.5	7.5	0
TOTAL[6]	1118.6	1118.6	0

[1]Negative outputs are the result of existing habitat types transitioning into other habitat types or being converted to wetlands through proposed activities.
[2]Approximately 3 years ago this area was farmed. Acres consist of naturally established early successional forest that has emerged since the land became fallow.
[3]Acres consist of early successional forest planted by MODNR since farming ceased.

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Figure 1: Current Conditions

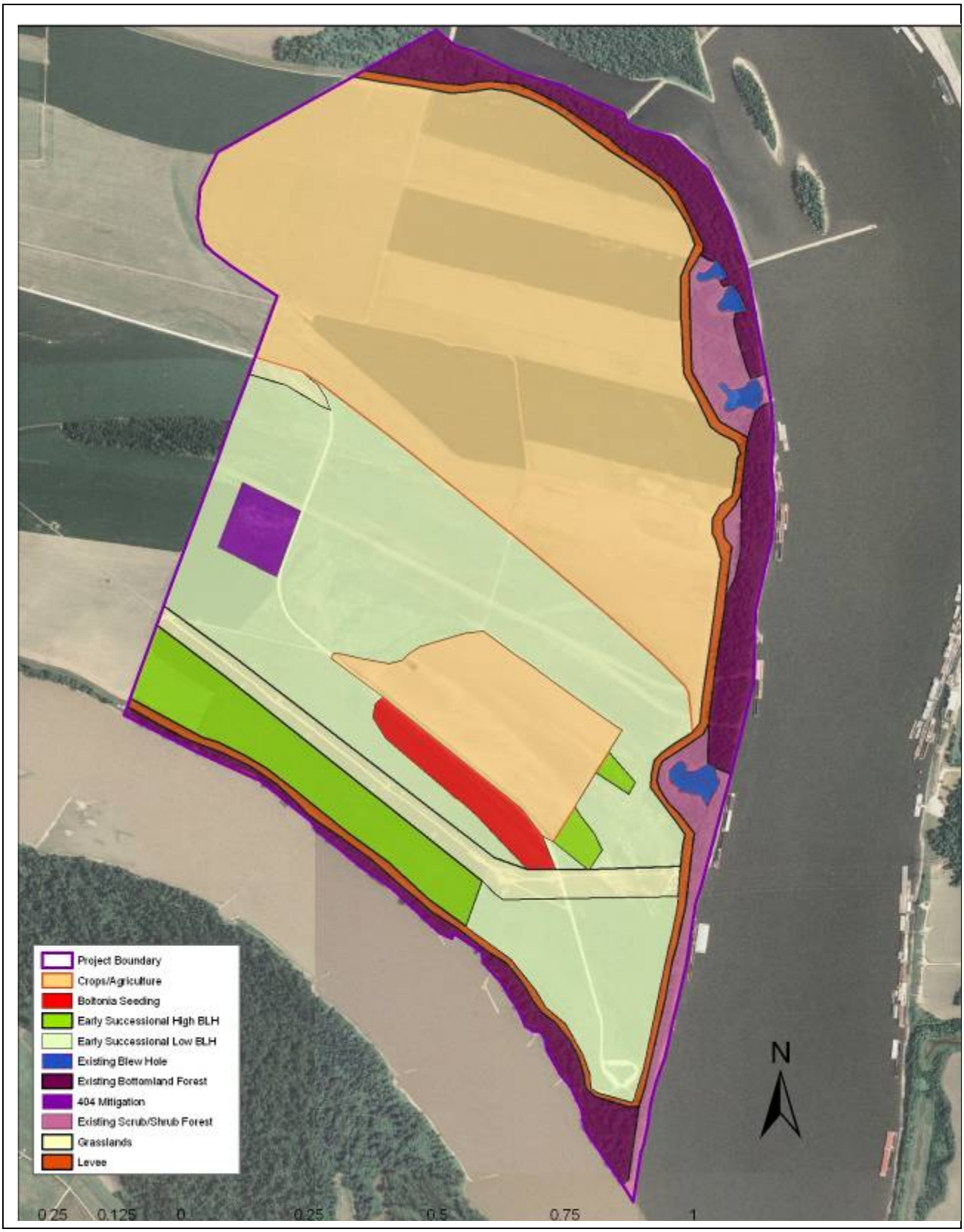
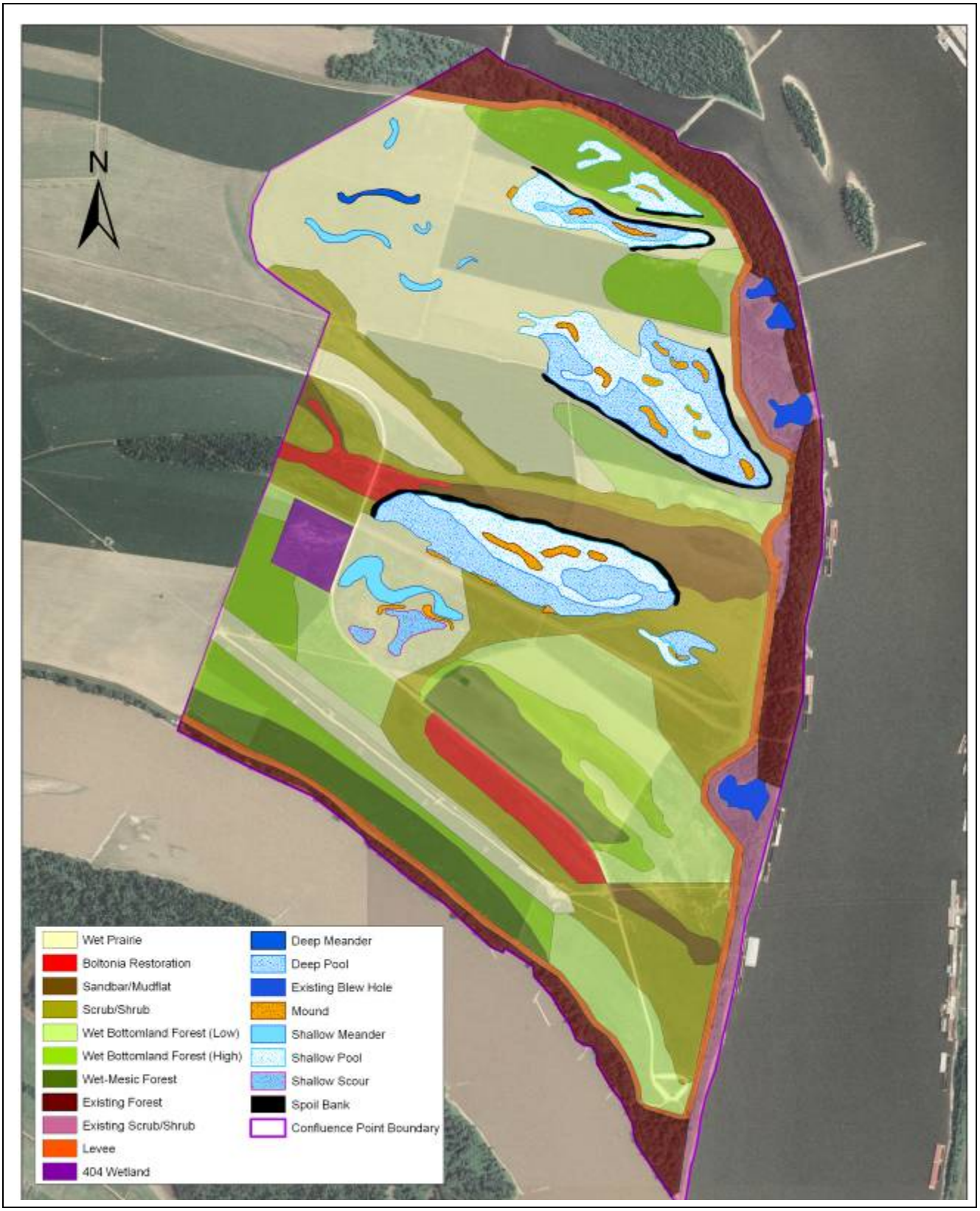


Figure 2: Proposed Future Conditions



Agency Correspondence Soliciation Letters

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
ROBERT A. YOUNG BUILDING - 1222 SPRUCE ST.
ST. LOUIS, MISSOURI 63103-2833

REPLY TO
ATTENTION OF

http://www.mvs.usace.army.mil

CEMVS-PM-E 28 March 2008

Jason W. Farmer
Environmental Analysis Branch - Biologist
(314) 331-8498
jason.w.farmer@usace.army.mil

Rene L. Cook
District Conservationist
USDA Natural Resources Conservation Service
St. Peters Service Center
160 Saint Peters Centre Blvd
St Peters, MO 63376

RE: Edward (Ted) and Pat Jones – Confluence Point State Park

Dear Ms. Cook,

The St. Louis District Corps of Engineers is proposing to perform an ecosystem restoration project at Edward (Ted) and Pat Jones – Confluence Point State Park (Confluence Point) as part of the Missouri River Fish and Wildlife Mitigation Program. This program was authorized by the Water Resources Development Acts of 1986 and 1999 to develop fish and wildlife habitat along the lower Missouri River from Sioux City, Iowa to the mouth near St. Louis, Missouri in order to mitigate for the loss of habitat that resulted from construction, operation, and maintenance of the Missouri River Bank Stabilization and Navigation Project. The overall program is managed by the Kansas City District Corps of Engineers. The Confluence Point project is being managed by the St. Louis District.

The Corps wishes to undertake actions to promote wildlife habitat at Confluence Point in a manner consistent with the goals of the Missouri River Mitigation Program. The Missouri Department of Natural Resources (MDNR) is the primary partner for this project. They, as well individuals from Missouri Department of Conservation's Wetland Reserve Program, have been highly involved with project development. As part of the documentation process a draft Project Implementation Report with an integrated Environmental Assessment (EA) is being prepared. This document will be made available for public review and comment upon completion.

As part of the EA, we are addressing issues related to farmland impacts. The site will be converted from agriculture to forest, wetland, and prairie. Although farmland will be converted to wildlife habitat, the changes are not irreversible. If the need arose for the site to be converted back into agriculture, there would be no infrastructure or urbanization in place to hinder this effort. Therefore, this project will not result in any permanent loss of farmland. We have provided a fact sheet that synopsizes the current plan for restoring the Confluence Point Site. Two maps are included within the fact sheet that show current conditions at the site as well as

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desired future conditions. In order to document our coordination with NRCS, Form AD-1006 is also included.

Thank you very much for your assistance in this matter.

Sincerely,

Jason Farmer

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
ROBERT A. YOUNG BUILDING - 1222 SPRUCE ST.
ST. LOUIS, MISSOURI 63103-2833

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CEMVS-PM-E 28 March 2008

Jason W. Farmer
Environmental Analysis Branch - Biologist
(314) 331-8498
jason.w.farmer@usace.army.mil

Jane Ledwin
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
101 Park DeVille Drive
Columbia, Missouri 65203

RE: Edward (Ted) and Pat Jones – Confluence Point State Park

Dear Ms. Ledwin,

The St. Louis District Corps of Engineers is proposing to perform an ecosystem restoration project at Edward (Ted) and Pat Jones – Confluence Point State Park (Confluence Point) as part of the Missouri River Fish and Wildlife Mitigation Program. This program was authorized by the Water Resources Development Acts of 1986 and 1999 to develop fish and wildlife habitat along the lower Missouri River from Sioux City, Iowa to the mouth near St. Louis, Missouri in order to mitigate for the loss of habitat that resulted from construction, operation, and maintenance of the Missouri River Bank Stabilization and Navigation Project. The overall program is managed by the Kansas City District Corps of Engineers. The Confluence Point project is being managed by the St. Louis District.

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As part of the EA, we are addressing issues related to wildlife and habitat. At the earliest convenience, we are requesting that the Fish and Wildlife Service provide us with the federal list of threatened and endangered species for the project area. In addition, please provide any additional pertinent information or comments that you would like considered in the EA. We will likely include this documentation with the Draft EA that we are preparing. We have provided a fact sheet that synopsizes the current plan for restoring the Confluence Point Site. Two maps are included within the fact sheet that show current conditions at the site as well as desired future conditions.

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Thank you very much for your assistance in this matter. Please do not hesitate to contact me with any question or comments.

Sincerely,

Jason Farmer

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
ROBERT A. YOUNG BUILDING - 1222 SPRUCE ST.
ST. LOUIS, MISSOURI 63103-2833

REPLY TO
ATTENTION OF

http://www.mvs.usace.army.mil

CEMVS-PM-E 28 March 2008

Jason W. Farmer
Environmental Analysis Branch - Biologist
(314) 331-8498
jason.w.farmer@usace.army.mil

Director John D. Hoskins
Missouri Department of Conservation
2901 W. Truman Boulevard
Jefferson City, Missouri 65109

RE: Edward (Ted) and Pat Jones – Confluence Point State Park

Director Hoskins,

The St. Louis District Corps of Engineers is proposing to perform an ecosystem restoration project at Edward (Ted) and Pat Jones – Confluence Point State Park (Confluence Point) as part of the Missouri River Fish and Wildlife Mitigation Program. This program was authorized by the Water Resources Development Acts of 1986 and 1999 to develop fish and wildlife habitat along the lower Missouri River from Sioux City, Iowa to the mouth near St. Louis, Missouri in order to mitigate for the loss of habitat that resulted from construction, operation, and maintenance of the Missouri River Bank Stabilization and Navigation Project. The overall program is managed by the Kansas City District Corps of Engineers. The Confluence Point project is being managed by the St. Louis District.

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As part of the EA, we are addressing issues related to wildlife and habitat. At your earliest convenience, we are requesting that you provide us with the state list of threatened and endangered species for the project area. In addition, please provide any additional pertinent information or comments that you would like considered in the EA. We will likely include this documentation with the Draft EA that we are preparing. We have provided a fact sheet that synopsizes the current plan for restoring the Confluence Point Site. Two maps are included within the fact sheet that show current conditions at the site as well as desired future conditions.

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Thank you very much for your assistance in this matter. Please do not hesitate to contact me with any question or comments.

Sincerely,

Jason Farmer

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Agency Replies:

-----Original Message-----
From: Jane_Ledwin@fws.gov [mailto:Jane_Ledwin@fws.gov]
Sent: Thursday, April 24, 2008 12:26 PM
To: Farmer, Jason W MVS
Cc: Charlie_Scott@fws.gov; ken.mccarty@dnr.mo.gov
Subject: Edward (Ted) and Pat Jones - Confluence State Park

In the interest of efficiency, I'm emailing you the Service's response to your March 28, 2008, request for information on federally listed species
in the vicinity of the Edward (Ted) and Pat Jones - Confluence State Park, St. Charles County, Missouri. The U.S. Army Corps of Engineers proposes to restore fish and wildlife habitats in this area as part of the Missouri River Fish and Wildlife Mitigation Program, now called Missouri River Recovery.

Endangered Species

The pallid sturgeon (Scaphirhynchus albus) is a large, wide-ranging benthic fish found throughout the Mississippi River and its major tributaries. The pallid sturgeon is adapted to large, free-flowing, turbid rivers with a diverse assemblage of physical characteristics that are in a constant state of change. Pallid sturgeon are known to travel large distances during spawning migrations. Habitat loss through river channelization and dams are two of the major factors responsible for the species decline. The project area includes important habitats for this species, including migration pathways, staging areas, and habitat for early life stages. Early developmental stages of pallid sturgeon spawned upstream potentially drift with the current through the project area. The confluence of the Missouri and Mississippi Rivers has been identified as a priority recovery area because of the high occurrence of pallids in the area. It is believe that the sturgeon aggregate in the area prior to spawning.

The Indiana bat (Myotis solalis) spends the winter hibernating in caves in the Ozarks. During April and May, females migrate north and establish small maternity colonies in suitable sites within wooded riparian areas, floodplain forests, or upland forests. Maternity roost sites tend to be in dead or dying trees greater than 9 inches in diameter at breast height and with loose exfoliating bark. Trees most likely to have loose or exfoliating bark are dead oaks, hickories, elms, green and white ash, silver maple, and eastern cottonwood, or living shagbark hickory. Preferred roost sites are located in forest openings, at the forest edge, or where tree canopy is sparse, and within 1 km or water. Indiana bats forage in and around the tree canopy of floodplain, riparian, and upland forest. No information has been provided to the Service pertaining to the presence of suitable Indiana bat maternity habitat within the forested wetland. A habitat survey of the site would be required to determine habitat suitability. However, based on the size of the trees and other characteristics of the forests, it is very likely that the forested wetland contains

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suitable Indiana bat maternity roost habitat. Furthermore, recent monitoring of radio-tracked Indiana bats in the vicinity of the project indicate that Indiana bats frequently use Missouri River floodplain forests as maternity roosts. A survey of the site for Indiana bats (from mid-May to mid-July), using a combination of mist-nets and acoustic detection (e.g., Anabat), would be required to determine if the species is using the forest as a maternity roost.

In addition, since the bald eagle has been delisted, we've been passing along the following guidance:

The riparian forests along the Missouri River provide nesting habitat for the bald eagle (Haliaeetus leucocephalus), which has officially been removed from the List of Endangered and Threatened Species as of August 8, 2007. Breeding bald eagles occupy "territories" that they will typically defend against intrusion by other eagles, and that they likely return to each year. A territory may include one or more alternate nests that are built and maintained by the eagles, but which may not be used for nesting in a given year. Nest sites typically include at least one perch with a clear view of the water or area where the eagles usually forage. Shoreline trees or snags located near large waterbodies provide the visibility and accessibility needed to locate aquatic prey. There is one bald eagle nest very near the confluence, and several additional nests within a couple of miles of the project area. Bald eagles are vulnerable to disturbance during courtship, nest building, egg laying, incubation, and brooding. Disturbance during this critical period may lead to nest abandonment, cracked or chilled eggs, and exposure of small young to the elements. Human activity near a nest late in the nesting cycle may also cause flightless birds to jump from the nest tree, thus reducing their chance of survival. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead).

Although the bald eagle has been removed from the threatened and endangered species list, it continues to be protected under the MBTA and the BGEPA. The Service developed the National Bald Eagle Management (NBEM) Guidelines to provide landowners, land managers, and others with information and recommendations regarding how to minimize potential project impacts to bald eagles, particularly where such impacts may constitute "disturbance," which is prohibited by the BGEPA. Those guidelines recommend maintaining: (1) a specified distance between the activity and the nest (buffer area); (2) natural areas (preferably forested) between the activity and nest trees (landscape buffers); and (3) avoiding certain activities during the breeding season. The buffer areas serve to minimize visual and auditory impacts associated with human activities near nest sites. Ideally, buffers would be large enough to protect existing nest trees and provide for alternative or replacement nest trees. On-site personnel should be informed of the possible presence of nesting bald eagles within the project boundary, and should identify, avoid, and immediately report any such nests to this office. A copy of the NBEM Guidelines is available at:

http://www.fws.gov/midwest/eagle/guidelines/bgepa.html
<http://www.fws.gov/midwest/eagle/guidelines/bgepa.html>

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http://www.fws.gov/permits/mbpermits/regulations/BGEPA.PDF
<http://www.fws.gov/permits/mbpermits/regulations/BGEPA.PDF>

If after consulting those guidelines you need further assistance in determining the appropriate size and configuration of buffers or the timing of activities in the vicinity of a bald eagle nest, please contact the USFWS ,Columbia, Missouri, Ecological Services Field Office at 573/234-2132.

Fish and Wildlife

The Service strongly supports this type of restoration along the Missouri River and has participated in several planning meetings with the Corps and project partners. The fact sheet enclosed with your letter provides a helpful description of the proposed activities at the park. We note that paragraph 5f refers to the potential to use adaptive management at this site. Based on our previous discussions, we believe the commitment to adaptive management at restoration sites is the most effective and appropriate framework to achieve maximum restoration value. While the fact sheet addresses project features on the existing tracts in public ownership, the Service suggests the EA mention the potential for reconnection with the river, if, in the future, additional properties are acquired, and such reconnection would not increase flooding risks to adjacent private lands .With that in mind, design of the current project should not foreclose potential future restoration opportunities should they arise.

Thank you for your coordination on this project. We look forward to working with the Corps and our state partners as this project progresses. Please call me if you have questions regarding our comments.

Regards -

Jane Ledwin
****
Jane Ledwin
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
101 Park DeVille Drive
Columbia, Missouri 65203
Phone 573/234-2132, extension 109
email jane_ledwin@fws.gov

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United States Department of Agriculture

NRCS

Natural Resources Conservation Service
10820 Hwy. 21, Suite 100
Hillsboro, Missouri 63050-5208
Fax: 636-789-2175

Phone: 636-789-2441 ext. 3

Subject: Habitat Restoration/Confluence Point Date: April 17, 2008

To: Jason Farmer
U.S. Army Corps of Engineers

Mr. Farmer,

I have reviewed the Habitat Restoration Plan at the Confluence Point State Park.

No farmland will be converted to a use requiring an AD-1006, Farmland Conversion Impact Rating.

The 511.9 acres of cropland will revert back to vegetation similar to the natural state originally, and could be returned to agriculture at some future date.

If further information or assistance is needed feel free to contact me.

David Skaer
NRCS Area Resource Soil Scientist

Cc Renee Cook, NRCS DC St. Peters, MO

The Natural Resources Conservation Service provides leadership in a partnership effort to help people conserve, maintain, and improve our natural resources and environment.

An Equal Opportunity Provider and Employer

MISSOURI DEPARTMENT OF CONSERVATION

Headquarters

2901 West Truman Boulevard, P.O. Box 180, Jefferson City, Missouri 65102-0180

Telephone: (573) 751-4115 ▲ Missouri Relay Center: 1-800-735-2966 (TTY)

JOHN D. HOSKINS, Director

May 2, 2008

Jason W. Farmer
Environmental Analysis Branch
St. Louis District, USACE
Robert A. Young Building
1222 Spruce St.
St. Louis, MO, 63103-2833

Subject: Heritage Review - Confluence Point Ecosystem Restoration Project

Dear Mr. Farmer:

As per your request, attached is a Heritage Review Report for the ecosystem restoration project at the Confluence Point State Park in St. Charles County, Missouri. There are two federally listed species identified: decurrent false aster (*Boltonia decurrens*) and pallid sturgeon. In addition, there are several species listed statewide as "imperiled" or "rare and uncommon" status.

Please follow prescribed best management practices to minimize potential impacts to the above listed species. If you have any questions, please call me at (573) 751-4115.

Sincerely,

STUART MILLER
POLICY COORDINATOR

COMMISSION

DON R. JOHNSON
Festus

CHIP McGEEHAN
Marshfield

LOWELL MOHLER
Jefferson City

BECKY L. PLATTNER
Grand Pass

Missouri Department of Conservation

Heritage Review Report

Policy Coordination Unit
P. O. Box 180
Jefferson City, MO 65102
Prepared by: Shannon Cave
shannon.cave@mdc.mo.gov
573-522-4115X3250

To: Stuart Miller

Project type:	Development of Ted & Pat Jones Confluence State Park
Location/Scope:	See map
County:	St. Charles
Query received:	April 3, 2008

Authenticity may be confirmed by Policy Coordination Unit, Missouri Department of Conservation, 573-522-4115.

This NATURAL HERITAGE REVIEW is not a site clearance letter. Rather, it indicates whether or not public lands and sensitive resources are known to be located close to and potentially affected by the proposed project.

FEDERAL LIST species/habitats are protected under the Federal Endangered Species Act. ***Consult with the U.S. Fish and Wildlife Service*** *(101 Park Deville Drive Suite A, Columbia, Missouri 65203-0007; 573-234-2132). STATE ENDANGERED species are listed in and protected under the Wildlife Code of Missouri (3CSR10-4.111).*

Records of federal listed or state endangered species/habitats or unlisted species/habitats of conservation concern within one mile of the project site:

Name	Common Name	Federal Status	State Status	State Rank	Last record
Boltonia decurrens	Decurrent False Aster	T	E	S1	2003-10-01
Boltonia decurrens	Decurrent False Aster	T	E	S1	2002-12-11
Scaphirhynchus albus	Pallid Sturgeon	E	E	S1	2004-05-11
Scaphirhynchus albus	Pallid Sturgeon	E	E	S1	2003-01-05
Scaphirhynchus albus	Pallid Sturgeon	E	E	S1	1978-06-28
Haliaeetus leucocephalus	Bald Eagle		E	S3	2007-01-18
Haliaeetus leucocephalus	Bald Eagle		E	S3	2007-01-18
Hybognathus placitus	Plains Minnow			S2	1983-09-07
Hybognathus argyritis	Western Silvery Minnow			S2	1983-09-07
Quadrula nodulata	Wartyback			S3	1988-08-26
Obovaria olivaria	Hickorynut			S3	1988-08-26
Macrhybopsis meeki	Sicklefin Chub			S3	1996-10-03
Macrhybopsis meeki	Sicklefin Chub			S3	1998-09-03
Macrhybopsis meeki	Sicklefin Chub			S3	2004-05-11
Macrhybopsis meeki	Sicklefin Chub			S3	1998-09-02
Macrhybopsis gelida	Sturgeon Chub			S3	1996-10-03
Macrhybopsis gelida	Sturgeon Chub			S3	2004-05-11
Macrhybopsis gelida	Sturgeon Chub			S3	2004-05-11
Macrhybopsis gelida	Sturgeon Chub			S3	1996-10-03
Cycleptus elongatus	Blue Sucker			S3	2004-05-11
Cycleptus elongatus	Blue Sucker			S3	2004-05-10
Cycleptus elongatus	Blue Sucker			S3	2004-05-11
Cycleptus elongatus	Blue Sucker			S3	2004-05-11
Cycleptus elongatus	Blue Sucker			S3	2004-05-11
Cycleptus elongatus	Blue Sucker			S3	2004-05-11
Cycleptus elongatus	Blue Sucker			S3	1998-09-01
Cycleptus elongatus	Blue Sucker			S3	1969-09-12
Arcidens confragosus	Rock Pocketbook			S3	1988-08-26

STATUS CODES: "Federal status" reflects listing under the federal Endangered Species Act as: E = Endangered, T = Threatened, C = Candidate, PE = Proposed Endangered for Federal listing.
"State Status" is either E, for "endangered," or blank.
"State Rank" codes are:

- *S1=Critically imperiled in the state due to extreme rarity or factor(s) making it especially vulnerable to extirpation (typically ≤5 occurrences or very few remaining individuals)*
- *S2=imperiled in the state due to rarity or factor(s) making it very vulnerable to extirpation from the state. (6 - 20 occurrences or few remaining*

- *S3=Rare and uncommon in the state. (21 to 100 occurrences)*

Heritage records were identified at some date and at a more or less precise location. This report includes information about records near but not necessarily on the project site. Animals move and, over time, so do plant communities. To say "there is a record" does not mean the species/habitat is still there. To say that "there is no record" does not mean the project will not encounter something not recorded. On-site verification is the responsibility of the project. Incorporating information from Heritage records into plans can help reduce adverse impacts to sensitive natural resources. However, these records only provide one reference and other information (e.g. wetland or soils maps, on-site inspections or surveys) should be considered. Compare biological and habitat needs of records listed to planned project activities to avoid or minimize impacts. More information may be found at www.mdc.mo.gov/nathis/endangered/ and mdc4.mdc.mo.gov/applications/mofwis/mofwis_search1.aspx.

Recommendations related to this project or site (not to specific heritage records):

- The Missouri and Mississippi River together with its tributary mouths and floodplains are home to a number of species of state and federal concern, including pallid sturgeon (*scaphirhynchus albus,* federal & state-listed "endangered"), lake sturgeon (*acipenser fulvescens*, state-listed "endangered"), and others.
  - Aquatic species are sampled at points but reflect presence for considerable distances upstream or down in appropriate habitats in this part of the Missouri River and tributary mouths. Projects that do not affect water quality or river channel, bed or banks are unlikely to affect aquatic species of concern.
  - The river's banks and floodplain are places one might encounter gray bats (*myotis grisescens*, federal & state-listed "endangered"), Indiana bats (*myotis sodalis,* federal & state-listed "endangered"), bald eagles (*haliaeetus leucocephalus*, state-listed "endangered") and others. While there are no specific records within a mile of any of the proposed activities, it is prudent to check the site and vicinity for eagle nests and to avoid cutting large trees with loose bark during summer months when Indiana bats may use them to rear young.

  Best management practices to follow if these situations are encountered may be found at http://www.mdc.mo.gov/nathis/endangered/.
- Bald eagles (*haliaeetus leucocephalus*) may overwinter or nest in the project area. Eagles are common winter residents in big river habitats and major lakes where they feed on fish. A decision by the U. S. Fish and Wildlife Service to remove the bald eagle from the "threatened" species list has become final, but the bald eagle remains on the Missouri list of endangered species. It continues to be protected by the federal government under the Bald and Golden Eagle Protection. See best management recommendations and federal guidelines at http://www.mdc.mo.gov/documents/nathis/endangered/baldeagle.pdf and http://www.fws.gov/migratorybirds/issues/BaldEagle/NationalBaldEagleManagementGuidelines.pdf.
- Decurrent false aster (*boltonia decurrens*, Federally threatened, State endangered) may occur in the project area in moist soils subject to periodic flooding. This species may appear in previously undocumented locations as water-borne seeds are deposited during periods of high water. Ditch banks and flood-prone areas of agricultural fields can support populations of decurrent false aster when shading and competition from other species is minimal. See http://www.mdc.mo.gov/documents/nathis/endangered/aster.pdf for best management recommendations.
- Pallid sturgeons (*scaphirhynchus albus*, federal & state-listed as "endangered") are big river fish that range widely in the Mississippi and Missouri River system (including parts of major tributaries). Much is unknown about the habitat needs and range of the species, so any project that modifies big river habitat or impacts water quality should consider the possible impact to pallid sturgeon populations. See http://www.mdc.mo.gov/documents/nathis/endangered/p_sturgeon.pdf for best management recommendations.
- Streams in the area should be protected from soil erosion, water pollution and in-stream activities that modify or diminish aquatic habitats. Best management recommendations relating to streams and rivers may be found at http://www.mdc.mo.gov/documents/nathis/endangered/streams.pdf.
- Invasive exotic species are a significant issue for fish, wildlife and agriculture in Missouri. Seeds, eggs, and larvae may be moved to new sites on boats or construction equipment, so inspect and clean equipment thoroughly before moving between project sites. Especially important at this time is the zebra mussel, known in the Missouri and Mississippi Rivers and Lake of the Ozarks, but missing from many inland streams and most lakes.
  - Remove any mud, soil, trash, plants or animals before leaving any water body or work area.
  - Before leaving a project site, drain water from boats and machinery (that has operated in the water), checking motor cavities, live-well, bilge and transom wells, tracks, buckets, and any other water

reservoirs.

- When possible, wash and rinse equipment thoroughly with hard spray or HOT (104° F or more) water, like that found at a do-it-yourself carwash and dry in the hot sun before using again. Please help prevent the spread of invasive species by inspecting and cleaning equipment thoroughly before moving between project sites.

➢ The project is within Confluence Conservation Opportunity Area, one of 35 in the state. COAs were identified based on several factors, including species diversity, presence of species of conservation concern, land-use trends and presence of landowners interested in wildlife conservation. COA designation has no regulatory role, but does reflect interest from multiple government agencies and citizen groups to work for conservation in the area. There may be ways your project or agency can contribute to or benefit from this COA. More information about it is available on line at http://www.mdc.mo.gov/nathis/cws/coa/.

These recommendations are ones project managers might prudently consider based on a general understanding of species needs and landscape conditions. Heritage records largely reflect only sites visited by specialists in the last 30 years. This means that many privately owned tracts could host remnants of species once but no longer common.

Project managers can pre-screen heritage review requests at http://mdcgis.mdc.mo.gov/heritage/newheritage/heritage.htm. A "Level 1 response" will result in a printable document that will make further submission to MDC or USFWS unnecessary.

Mailed

June 5, 2008

Engineering and Construction Division
Curation and Archives Analysis Branch

COPY

Mr. Scott Miller, Governor
Absentee-Shawnee
2025 South Gordon Cooper Drive
Shawnee, Oklahoma 74810-9381

Dear Governor Miller:

This letter addresses the Habitat Restoration Project at the Edward and Pat Jones–Confluence Point State Park, which is located at the eastern tip of St. Charles County, Missouri, and spans the distance between the main channels of the Missouri and Mississippi Rivers at their junction. This state park is a 1,118-acre property consisting of two sections, with the northern section consisting of 532 acres that was purchased by the U.S. Army Corps of Engineers in 2007 and remains in Corps ownership. The Missouri Department of Natural Resources, which owns the remaining acreage, is the primary partner for this project and has responsibility for long-term management of the state park.

This project focuses on developing fish and wildlife habitat with emphasis on native vegetation and natural wetlands suitable for the site's current soil. Attached you will find a detailed fact sheet with all the information concerning this project. The archaeology investigation has been completed, and no archaeological sites will be disturbed. Should an inadvertent discovery of Native American human remains occur, then Section 3 of the Native American Graves Protection and Repatriation Act will be followed.

All of the following tribes are being notified regarding this project as potential interested parties:

Absentee Shawnee Tribe
Eastern Shawnee
Shawnee Tribe
Cherokee Nation of Oklahoma
United Keetoowah Band of Cherokee
Delaware Nation
Sac & Fox Nation of Oklahoma
Sac & Fox Tribe of Iowa
Sac & Fox Nation of Kansas
Ho-Chunk Nation
Winnebago Tribe
Iowa Tribe of Kansas
Iowa Tribe of Oklahoma

Kickapoo Tribe of Oklahoma
Kickapoo Traditional Tribe of Texas
Kickapoo Tribe of Kansas
Miami Tribe
Osage Nation
Citizen Potawatomi Nation
Forest County Potawatomi
Pokagon Band of Potawatomi
Nottawaseppi Band of Huron Potawatomi
Prairie Band of Potawatomi
Gun Lake Potawatomi
Hannahville Indian Community
Peoria Tribe

If you have further questions or need additional information, please contact Ms. Roberta Hayworth at 314-331-8833. Please send all comments and concerns by July 18, 2008, to Ms. Hayworth, the St. Louis District Native American coordinator, at the following address:

U.S. Army Engineer District, St. Louis
ATTN: CEMVS-EC-Z (Hayworth)
1222 Spruce Street
St. Louis, Missouri 63103-2833
E-Mail: Roberta.l.hayworth@usace.army.mil

Sincerely,

Signed

Michael K. Trimble, Ph.D.
Chief, Curation and Archives
Analysis Branch

Enclosure

Copy Furnished:

Ms. Karen Kaniatobe

SAME LETTER SENT:

TRIBAL CHAIRPERSONS

Mr. Scott Miller, Governor
Absentee-Shawnee Tribe
2025 S. Gordon Cooper Drive
Shawnee, OK 74810-9381

Ms. Glenna J. Wallace, Chief
Eastern Shawnee Tribe
P.O. Box 350
Seneca, MO 64865

Mr. Ron Sparkman, Chairman
Shawnee Tribe
P.O. Box 189
Miami, Oklahoma 74355

Mr. Chad Smith, Principal Chief
Cherokee Nation
P.O. Box 948
Tahlequah, OK 74465

Mr. George Wickliffe, Chief
United Keetoowah Band of Cherokee
P.O. Box 746
Tahlequah, OK 74464

Mr. Kerry Holton, President
Delaware Nation
P.O. Box 825
Anadarko, OK 73005

Mr. John Barrett, Chairman
Citizen Potawatomi Nation
1601 S. Gordon Cooper Drive
Shawnee, OK 74801

Mr. Harold Frank, Chairman
Forest County Potawatomi
P.O. Box 340
Crandon, WI 54520

Mr. D.K. Sprague, Chairman
Gun Lake Potawatomi
P.O. Box 218
Dorr, MI 49323

Mr. Kenneth Meshigand, Chairman
Hannahville Indian Community
N14911 Hannahville Blvd. Rd.
Wilson, MI 49896-9728

Ms. Laura Spurr, Chairwoman
Huron Potawatomi Nation
2221—1 ½ Mile Road
Fulton, MI 49052

Mr. John Miller, Chairman
Pokagon Band of Potawatomi
P.O. Box 180
Dowagiac, MI 49047

Mr. Steve Ortiz, Chairman
Prairie Band of Potawatomi
Government Center
16281 Q Road
Mayetta, KS 66509

Mr. Wilfrid Cleveland, President
Ho-Chunk Nation
P.O. Box 667
Black River Falls, WI 54675

Mr. Matthew Pilcher, Chairman
Winnebago Tribe of Nebraska
P.O. Box 687
Winnebago, NE 68071

Mr. Leon Campbell, Chairman
Iowa Tribe of Kansas
3345 Thrasher Road # 8
White Cloud, KS 66094

Ms. Bernadette Huber, Chairwoman
Iowa Tribe of Oklahoma
Route 1, Box 721
Perkins, OK 74059

Mr. Juan Garza, Chairman
Kickapoo Traditional Tribe of Texas
HC 1, Box 9700
Eagle Pass, TX 78853

Mr. Tony Salazar, Chairman
Kickapoo Tribe of Oklahoma
P.O. Box 70
McCloud, OK 74851

Mr. Steve Cadue, Chairman
Kickapoo Tribe of Kansas
P.O. Box 271
Horton, KS 66439

Ms. Kay Rhoads, Principal Chief
Sac & Fox Nation of Oklahoma
Route 2, Box 246
Stroud, OK 74079

Ms. Fredia Perkins, Chairwoman
Sac & Fox Nation of Missouri
Rt. 1, Box 60
Reserve, KS 66434

Mr. Homer Bear, Jr., Chairman
Sac & Fox Tribe of Mississippi In Iowa
3137 F. Avenue
Tama, IA 52339

Mr. Thomas E. Gamble, Chief
Miami Tribe of Oklahoma
P.O. Box 1326
Miami, OK 74355

Mr. Jim Gray, Principal Chief
Osage Nation of Oklahoma
P.O. Box 779
Pawhuska, OK 74056

Mr. John Froman, Chief
Peoria Tribe
P.O. Box 1527
Miami, OK 74355

Mr. John Berrey, Chairman
Quapaw Tribe of Oklahoma
P.O. Box 765
Quapaw, OK 74363

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SAME LETTER SENT:

TRIBAL REPRESENTATIVE:

Ms. Karen Kaniatobe
Absentee-Shawnee Tribe
2025 Gordon Cooper Drive
Shawnee, Oklahoma 74810-9381

Ms. Robin DuShane
Eastern Shawnee Tribe
P.O. Box 350
Seneca, MO 64856

Ms. Rebecca Hawkins
Shawnee Tribe
P.O. Box 189
Miami, OK 74355

Dr. Richard Allen
Cherokee Nation
P.O. box 948
Tahlequah, Oklahoma 74465

Ms. Lisa Stopp
United Keetoowah Band of Cherokee
2450 S. Muskogee Avenue
Tahlequah, Oklahoma 74464

Ms. Tamara Francis
Delaware Nation
P.O. Box 825
Anadarko, Oklahoma 73005

Mr. Jeremy Finch
Citizen Potawatomi Nation
1601 S. Gordon Cooper Dr.
Shawnee, Oklahoma 74801

Mr. Vince Leppart
Forest County Potawatomi
5460 Everybody's Road
P.O. Box 340
Crandon, Wisconsin 54520

Mr. Floyd Rhode
Hannahville Indian Community
P.O. Box 351, W 399
Highway 2 & 42
Harris, Michigan 49845

Ms. RoAnn Beebe-Mohr
Huron Potawatomi Nation
2221—1 ½ Mile Road
Fulton, Michigan 49052

Mr. Mark Parrish
Pokagon Band of Potawatomi
P.O. Box 180
58620 Stink Road
Dowagiac, MI 49047

Mr. Rey Kitchkumme
Prairie Band of Potawatomi
Government Center
16281 Q Road
Mayetta, KS 66509

Mr. Larry Garvin
Cultural Resources Division
Ho-Chunk Nation of Wisconsin
P.O. Box 667
Black River Falls, WI 54615

Mr. William Quackenbush
Ho-Chunk Nation of Wisconsin
P.O. Box 667
Black River Falls, WI 54615

Mr. David Smith
Little Priest Tribal College
P.O. Box 270
Winnebago, Nebraska 68071

Mr. Charles Aldrich
Tribal Council Member
Winnebago Tribe of Nebraska
P.O. Box 687
Winnebago, Nebraska 68071

Mr. Patt Murphy (NAGPRA only)
Iowa Tribe of Kansas and Nebraska
204 South Buckeye
Salina, Kansas 67410

Mr. Danny Kaskaske
Kickapoo Tribe of Oklahoma
P.O. Box 70
McCloud, Oklahoma 74851

Mr. Joe Williams
Kickapoo Tribe of Kansas
P.O. Box 270
Horton, Kansas 66439

Ms. Sandra Massey
Sac & Fox Nation of Oklahoma
Route 2, Box 246
Stroud, Oklahoma 74030

Ms. Jane Nioce
Sac & Fox Nation of Missouri
305 North Main Street
Hiawatha, Kansas 66434

Mr. Edmore Green
Sac & Fox Nation of Missouri
305 North Main Street
Hiawatha, Kansas 66434

Mr. Jonathan Buffalo
Sac & Fox of the Mississippi
3137 F Avenue
Tama, Iowa 52339

Mr. Joshua Sutterfield
Miami Tribe
P.O. Box 1236
Miami, Oklahoma 74355

Dr. Andrea Hunter
Osage Tribe
P.O. Box 779
Pawhuska, Oklahoma 74056

Mr. Emmett E. Ellis
NAGPRA Representative
Peoria Tribe
6435 south Quebec Avenue
Tulsa, OK 74136

Ms. Carrie Wilson
Quapaw Tribe of Oklahoma
c/o Arkansas Archeological Survey
2475 North Hatch Ave.
Fayetteville, Arkansas 72701

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Appendix B
Technical Documents

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Edward (Ted) and Pat Jones – Confluence Point State Park Draft Revegetation and Restoration Plan

Missouri Department of Natural Resources

Ken McCarty, Natural Resource Management Section
Dennis Meinert, Soils Program
Charles DuCharme, Water Resources Program

Missouri Department of Natural Resources
Edward (Ted) and Pat Jones – Confluence Point Revegetation Plan
March 18, 2004 draft

Abstract: This restoration and revegetation plan contains the analysis of the topography, soils and hydrology of the confluence point property. It also describes the area's historic vegetation with detailed accounts of their modern natural community analogs. Using this as its foundation, the restoration plan produces a vegetation model that largely matches the existing landform and physical environments with the suitable native plant communities. The intent is to match the vegetation to the existing landform, rather than re-shape the land to support a vegetation list. On completion the park should have a very natural look that reflects the examples offered by Missouri Natural Areas and other old-growth natural ecosystems along the Missouri and Mississippi rivers, yet recognizes the dynamic nature of floodplain ecosystems and the modern alterations of the rivers and their floodplains. A secondary goal is for this diverse array of native ecosystems to attract native birdlife and wildlife, and hopefully also provide shallow backwater areas suitable for spawning of big-river fish. Towards these goals six restoration objectives are presented and described, along with an outline of immediately important actions to be taken.

The plan projects a mixed vision of prairie, forest and wetlands. Much will be low riverfront forests of cottonwoods, silver maples and elms that are interrupted by seasonally wet sloughs and ponds. The Missouri River will be bordered by a high natural levee with groves of hardwoods, while the relatively high, but poorly drained "plain" to the northwest will be covered in wet prairie and groves and borders of pin and swamp white oak. The prairie will be interspersed by marshes occupying shallow, seasonally inundated depressions, and a large marshy lake will be constructed at its low end. The low swale where water now ponds will be deepened to hold water longer and support fish and bird life.

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Introduction: The restoration vision for Confluence Point State Park is a natural floodplain reminiscent of what Lewis and Clark might have seen along the lower Missouri River two hundred years ago. This vision emphasizes native vegetation and the natural wetlands suitable for the site's current soil, topography and hydrology. It reflects the examples offered by Missouri Natural Areas and other old-growth natural ecosystems along the Missouri and Mississippi rivers, yet recognizes the dynamic nature of floodplain ecosystems and the modern alterations of the rivers and their floodplains.

This plan is meant to serve as a blueprint and reference for the restoration at Confluence Point. It begins with descriptions of the historic vegetation at the confluence, then profiles the current soil, topography and hydrology, and summarizes vegetation models from contemporary natural areas. Based on inundation patterns, the park is then divided into wetland zones, and for each zone a list of compatible natural community types is identified. According to the soil types within each zone, natural community restoration targets are then identified. The general actions or strategies that will be necessary to achieve the targets are divided into five planning objectives, and summarized.

Planning began when representatives from several resource agencies met on August 27, 2003 to discuss restoration options for Confluence Point. This meeting included representatives from the Natural Resources Conservation Service, Missouri Conservation Department, U.S. Fish and Wildlife Service, including both the Columbia Ecological Field Services Office and the Big Muddy National Wildlife Refuge, and the Missouri Department of Natural Resources. This group reviewed the detailed soil and topography maps, and long-term river gage information that had been collected. They made several recommendations that became the starting point for this plan.

Most importantly, this group felt that within the context of restoring a native and natural floodplain, the proper soils and a functional wetland hydrology already exist. They recommended working with the existing hydrology and land configuration, adding options for minor excavations or surface modifications that mimic natural floodplain topography, to provide more seasonal or permanent water bodies. Their only major structural recommendation was for weirs or gates to allow better fish ingress and egress through the levee during higher river stages.

Because Confluence Point is very low and frequently inundated, there is no need or desire for complex water delivery and holding systems. At this time, no preference exists for opening the levee or creating overflow channels across the property. The hydrology should follow the ebb and flow of the Mississippi and Missouri rivers as it now exists, and the major restoration challenge at Confluence Point will be revegetation to match this hydrology and soils.

The park is currently almost all being farmed. The 552 acres leased from Confluence Greenway will remain in agriculature until a restoration plan is completed and approved. In the south half of the park agriculture is being phased out at a rate of about 100 acres per year (see map, Appendix 1), with about two hundred acres already removed in 2003 and 2004. Certain parcels are reserved for agriculture until as late as 2008. In its place must come a natural mosaic of forest, marsh, shrub swamp, seasonal wet depressions and wet prairie; all arranged to appear as natural as possible. Even with natural vegetation as goals, success depends on specific techniques and planning that causes the vegetation targets to coincide with the current soils and hydrology. There is no desire to establish hardwood tree species, or prairie species, that belong to drier environments than naturally exist at the site.

The plan is divided into two sections. Part One compiles and reviews the available information, and Part Two pulls that information into the restoration plan.

Part One: Planning

Historic vegetation: The Mississippi and Missouri rivers converged over the Jones-Confluence Point State Park location when the first general land survey was done in 1819. The Lewis and Clark expedition probably boated across it on the afternoon of May 14th, 1804, and when expedition member Joseph Whitehouse wrote that *"The River Misouri is about one Mile wide, and on the South side of it near its mouth is an Islan.*" he

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was unknowingly describing the future park's historic appearance. The island he mentions falls partly within modern park boundaries, and lay opposite the Lewis and Clark winter camp of 1803-04. It was noted in their journal as a small island on the starboard side with a settlement on its lower side, which did not appear to have suffered any recent floods. Captain William Clark himself gave another impression of the future park site on a bitterly cold January 3, 1804, when he looked across it from Camp DuBois and wrote,*"all the after part of the Day the wind so high that the View up the Missouri appeared Dredfull, as the wind blew off the Sand with fury as to Almost darken that part of the atmespear this added to agutation of the water apd. Truly gloomy."*

The first land survey in 1817 confirms that in early historic times most of the park was river channel, with the only solid land high enough to map being the lower tip of one large river island. Unless cleared for farm fields this island was likely*"overgrown with cottonwoods of enormous dimension"*, its banks *"so overgrown with wild grapevines that it was impossible to put the crew on land to pull the boat by towline"*as Paul Wilhelm, Duke of Wurttemberg described several lower Missouri river islands in 1822 (Wilhelm, 1835). In summer and fall when the river was low, other small sandbars and islands would have appeared where the park now sits. Zebulon Pike (1805) and others wrote of their abundance on the Mississippi side where the Illinois River emptied its load of sand just upstream from the confluence. The lowest of these would have only a scattering of small willow, river birch and cottonwood seedlings, and newly sprouted rushes and nutsedges. Or they might be as Wilhelm described *"completely bare but everywhere covered with the white wooly seed of the cottonwood, they will soon be overgrown with this variety of wood, so common here"*. Slightly higher bars and islands would be covered in dense sandbar willow or cottonwood thickets along with elderberry and a host of plants adapted to life on shifting sand and mud flats (Hus, 1908).

When Lewis and Clark saw it, the actual confluence point was located about two miles upstream from its present location. Zebulon Pike boated past the confluence in 1805 and from his riverside view wrote that the west shore of the Mississippi was *"a rich prairie, with small skirts of woods."* The naturalist Henri Brackenridge gained an expansive view atop one of the three high hills (known as "the Mamelles") east of St. Charles in 1811, and wrote: *"To the right, the Missouri is concealed by a wood of no great width, extending to the Mississippi, a distance of ten miles. Before me I could mark the course of the latter river, its banks without even a fringe of wood"*. He was looking across the long alluvial peninsula formed by the two rivers that was called "Mamelle" or "Point" Prairie (Schroeder, 1982). Botanist Edwin James visited the same spot eight years later and found that from *"The point between the Missouri and Mississippi, near their confluence . . . extends an irregular tongue of land, destitute of timber, and everywhere nearly of the same elevation"*. He speculated that *" it had been part of a great plain; left naked at the retiring of the ocean, and in which the vast vallies of the Missouri and Mississippi, had since been excavated by the operations of those streams"*. Nicholas Biddle wrote that *"from St. Charles to the mouth of the river is a rich bottom – timber mostly confined to the mouth of the river,"* while the south side of the river was tolerably well timbered. (Biddle, 1810). George Featherstonaugh visited the Mamelles in 1834 and also spoke of the *"fine view of the extensive prairie at their foot"*, which Timothy

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Flint said rose above the Missouri and Mississippi rivers as *"the vast and most beautiful Mamelle prairie, dotted with green islands of wood, and skirted at the furthest ken of eye with hills and forests"* (Flint, 1828). Looking across Mamelle prairie from the bluffs west of modern Alton, Flint thought this *"one of the most impressive and beautiful landscapes in the world."* Henri Brackenridge was equally eloquent but even more descriptive when he portrayed the view across point peninsula as *". . . the ocean of prairie, with islets at intervals. The whole extent perfectly level, covered with long, waving grass, and at every moment changing color from the shadows cast by the passing clouds. In some places there stands a solitary cottonwood or walnut, of enormous size, but, from the distance, diminished to a shrub. A hundred thousand acres of the finest land are under the eye at once, and yet in all this space there is but one little cultivated spot to be seen."* Point Prairie went far beyond the confluence when Amos Stoddard saw it in 1812, stretching from the mouth of the Missouri along the west bank of the Mississippi *"about sixty five miles . . . and the width of it is from four to six miles, and in some places it exceeds ten miles." The soil is of luxuriant nature, and yeilds in abundance; but the want of wood and spring water, of which this prairie is destitute, obliges settlers to plant themselves on the margin of the high grounds."* (Stoddard, 1812).

Clearly, the historic vegetation was dominated by prairie grasslands from confluence point all the way to Portage des Souix and well up the Mississippi. But unfortunately the composition of what we now call wet prairies was not often described by the early travelers, nothing like the tree lists they offered for the forests. Timothy Flint gave a small glimpse when he wrote how the alluvial prairies on the lower courses of the Missouri teem with swamp grass and other vegetation. According to him, *"alluvial or wet prairies generally occur on the margins of the great water courses. They rear their own native grasses of astonishing height and luxurience. An exact account of the size and rankness of the weeds, flowering plants and grass on the richer alluvial prairie of Illinois and Missouri, would seem, to those who have not seen them, and idle exaggeration."* Amos Stoddard referred specifically to Mamelle Prairie when describing the luxuriant prairie soil that lacked for settlers for want of wood and spring water. A 1784 geographer named Thomas Hutchins wrote that the fertile lowland meadows across the river on the American bottoms as *"yielding shrubs and most fragrant flowers, which added to the number and extent of meadows and ponds dispersed through this charming valley, render it exceedingly beautiful and agreeable"* (Inventory of the Archives of Illinois, 1939). For comparison, modern wet prairie remnants are perennial grasslands dominated by prairie cordgrass with abundant sedges, other grasses and broad-leaved plants. True bottomland "cordgrass" prairies occur over areas of well-developed soils, usually clayey, that experience frequent short-duration flooding. They do not tolerate heavy sedimentation, and they require fire for their development and persistence. Higher, better drained soils that could be found on natural levees and terraces also supported prairie, populated by species such as big bluestem and Indiangrass.

Treeless areas that retained water or were frequently worked by river currents would also have held herbaceous vegetation, though not the characteristic prairie plants. Whenever scour channels and depressional wetlands dried to expose flats of mud or sand, a wide assortment of annual and biennial plants flowered. Henri Hus (1908) described sandy

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areas where weedy pigweeds *"take complete possession"* and where cockleburs, biennial gaura, beggar ticks and other modern "weeds" were the natural vegetation. Paul Wilhelm in 1822 found "*waste spots on which I found some twenty-foot high dry stalks of an annual helianthes which seemed to agree with a variety of Helianthus annus* [common sunflower]." Such is also the natural environment for the now-endangered *Boltonia decurrens*.

As both Hutchins and Flint also observed, some water-filled depressions held water long enough to form natural sloughs, ponds, lakes and marshes on the flat alluvial prairie. These would occur where the soil was very clayey and held water in a perched water table, or where depressions reached down to the permanent water table. Henri Hus explained that lakes on the American Bottoms that were near the river tended to be open and without timber borders. These and sloughs *"were always bordered by herbs accompanied by a few trees and shrubs, of which the principle are water locust, kentucky coffee tree, buttonbush and river birch."* He said that sedges were frequent around their borders, and listed many species of wet meadow plants that would have grown in the wet or saturated soil around their margins. Shallow water held several duck potato species, water plantain, dock, lizardtail and springcress, along with typical mudflat species. Water willow was common, and in places formed a continuous band 6 feet wide. Where the water was deeper, *"bur-reed occurs near the bank in the water, slightly before a row of cattails which in many places fringes the banks."* He lists several species of pondweed, water cress, yellow pond lilly and white water lilly. Timothy Flint also wrote of *"ponds in the alluvial prairies, that are connected with the rives"* and of those "*which fill from the rivers, and from the rains, and are only carried off, during the intense heat of summer, by evaporation"*. He described how they fill with fish during high water, which are removed "by cartloads" among the tall grass when the water was three or four feet deep. During the heat of the summer the water would evaporate, killing fish trapped in these small natural marshes and ponds and *" although thousands of buzzards prey upon them, they become a source of pollution to the atmosphere."* (Flint, 1832).

Unlike the Mississippi, the Missouri River floodplain above St. Charles was largely timbered. Timothy Flint wrote in 1832 that while wet prairie touched the Mississippi River for most of the distance of 70 miles above its junction with the Missouri, *"Prairies are scarcely seen on the banks of the Missouri within the distance of the first four hundred miles of its course"* (Flint, 1832). Across the river in the historic American Bottoms, which lie opposite the Mississippi River from confluence point on the east, George Featherstonaugh suffered a "tedious swampy drive" before he reached the river at St. Louis. He was traveling through a belt of riverfront woods described in the Illinois archives as being *"heavily forested with giant trees, thickly undergrown with brush and interwoven with vines"* for the width of a mile or so alongside the river (Inventory of the County Archives of Illinois, St. Clair County, 1939).

The kind of forest that grew in the region's floodplains depended on the physical situation. Rows or belts of cottonwoods usually lined the river banks. The first General Land Office (GLO) survey opposite confluence point around the mouth of the Illinois River in 1809 recorded cottonwoods and sycamores more frequently than any other river

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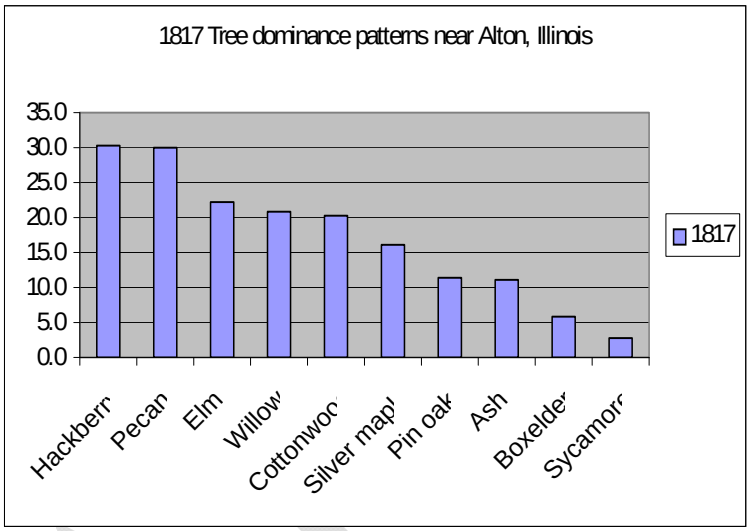
border tree (Yin and Nelson, 1996). When Edwin James wrote of riverbanks falling into the lower Missouri river, he noted numerous trees *"commonly cottonwoods and willows"* being overturned into the water. He said that these two species also *"root in the fertile ramifications of the Mississippi, prevailing almost to the exclusion of other trees"*, and of how he descended into the deep cottonwood forests of the Missouri bottom just west of St. Louis. Duke Wilhelm described how the Missouri's bank for some distance above St. Charles was low and *"covered with particularly tall cottonwoods and sycamores"*. He noted surprise at the few number of flowering plants along the banks, *"which was so rich in various trees and bushes"*, and commented on how heavily the undergrowth was entangled by grapevines. Timothy Flint considered cottonwoods to be the most abundant tree on the lower Missouri. He too, noted the abundance of grape vines where in some places *"half the trees in the bottom"* would be covered by them. Edwin Janes mentioned elderberry (*Sambucus canadensis*) as another common riverside plant.



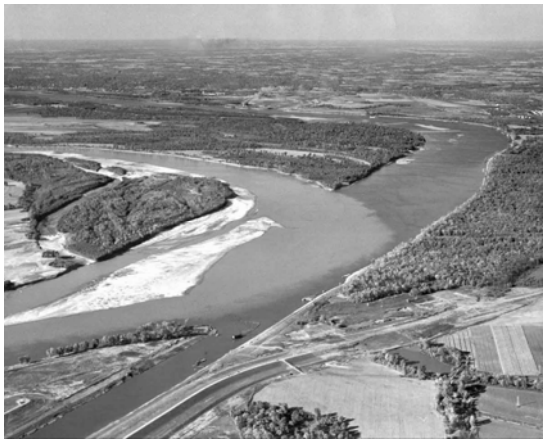
Further inland from the riverbank, William Clark distinguished between "low bottoms" of cottonwood and willow, and "high bottoms" of cottonwood, walnut, ash, hackberry, mulberry, basswood and sycamore. Henri Hus's 1907 thesis study of vegetation in the American bottoms similarly described a zone of low wet forest of willows, river birch and water locust near the river. This was situated below the higher forests of bitternut hickory, pecan, swamp white, pin and bur oaks, honey locust, cottonwood, hackberry, Kentucky coffee tree, river birch and American and slippery elms. The American Bottoms also included abundant "swamps" of silver maple, sandbar and black willow, swamp white and pin oaks associated with the many shallow lakes (Hus, 1908) and poorly drained grounds near them. A review of the General Land Office reports for Missouri shows the typical floodplain forest along the Missouri in the early 1800's was dominated alternately by hackberry and elm, with sycamore being the third most common tree (Harlan and Denny, 2003). The first General Land Office surveys at the confluence of the Illinois an Mississippi Rivers just across the river north of the park in 1817 recorded 18 species of witness trees, with the most common being hackberry, cottonwood, pecan, elm, willow, silver maple, pin oak and ash (Yin, 1996). Bottomland hardwood forests that included several oaks, basswood, mulberry, walnut and shellbark hickory were rare along the Missouri River. Along the Mississippi, Zebulon Pike did not mention oaks or hickories in his riverbottom tree lists until they reached the mouth of the Salt River, well above the confluence area. These would only have been found on more mature soils high above the waterline that were well protected from flooding and

sediment deposition. The most common occurrence would be in narrow belts on high terraces or natural levees that did not flood extensively. Such did not occur near the confluence in early historic times.

From all descriptions it is clear that for low-elevation zones similar to most of the Confluence Point even today, the typical floodplain forest in early historic times grew disturbance- and water-tolerant species that were associated with frequently flooded areas of new alluvial soils. Yin describes how they began as pioneer forests of cottonwood and willow colonizing new alluvial soils, and matured into forests of elm, hackberry, boxelder, silver maple and others according to soil properties and flooding patterns. Most were eroded away by the river and restarted as new colonies of young cottonwoods and willows, rather than transitioning to bottomland hardwoods. Edwin James gives us an 1819 observation of this process. He wrote how *"The forests, on the low grounds immediately in the vicinity of the Missouri, are remarkably dense; but in many instances, the young willows and poplars (which are the first and almost the only trees, that spring up on lands left naked by the river) have not attained half their ordinary dimensions, before, by another change or direction of the current, they are undermined and precipitated down, to be borne away by the river."* If not scoured away, frequent inundation or saturated soils and siltation precluded establishment of many common hardwood trees and other plants of drier environments.

These 18th century descriptions are very helpful in understanding the historic vegetation patterns in the confluence vicinity, but they also only tell part of the story. They identify the trees but only give intermittent references to the plants or vegetation patterns in the forests or within the prairies and marshes, even though modern remnants show that each is a robust and rich natural community with its own distinguishing array of species.

Many of these plants are highly specialized and there is much variety among each major vegetation type that is indicative of particular soil and hydrologic characteristics that will pinpoint the communities appropriate for a site with much finer resolution than can the trees alone. Many of these shrub and herbaceous plants should be restoration targets themselves, as they are so rare or distant from the modern confluence that they will not re-establish on their own. More complete descriptions of river floodplain natural communities may be found in the **Modern Potential Natural Vegetation** and **Native Vegetation Models** sections of this plan, or observed in similar Missouri Natural Areas.



It must also be recognized that situations have changed since the days of these historic forests. Levees and navigation structures have changed the hydrologic regime, constricting floodwaters and increasing the frequency, duration and elevation of floods while making the land they protect

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normally drier than it otherwise would be. As the chart below shows, the natural forests of 1992 are not identical to those of 1817. Between the levees, flood tolerant species are favored. Outside the levees, conditions are drier and other species grow where they historically would not. Some species of hardwoods are now planted that can only survive in the shadows of levees. Another change is that heavy sediment deposition in backwaters now favors silver maple over most other species, and this has become the most abundant tree in most wet bottomlands (Nelson et al, 1994). The aerial photo from ca 1940's taken when the modern Confluence Point was covered in timber, shows this kind of thick forest as the most recent historic natural vegetation at Confluence Point.

Tree Dominance Patterns near Alton, Ill	1817	1992
Hackberry	30.4	19.7
Pecan	30.0	9.1
Elm	22.1	8.7
Willow	20.7	12.9
Cottonwood	20.4	13.1
Silver maple	16.1	86.3
Pin oak	11.5	9.5
Ash	11.0	17.9
Boxelder	5.8	14.7
Sycamore	2.8	1.9

Adapted from Nelson et al, 1994

While the exact landform has changed since 1819, the general soil types and the processes of frequent flooding with periodic scouring and deposition still exist alongside the Missouri River at its confluence with the Mississippi. These are conditions that the historic native plant species were adapted to, and the plant species lists for several present-day natural communities still very closely match those recorded a century and mo re ago. These are the elements that link the modern landscape to its historic past, and will drive restoration of a landscape appropriate for the modern natural conditions that is reminiscent of the historic native composition.

Recent History

The land which now comprises the Edward (Ted) and Pat Jones Confluence State Park has accreted from modern alluvial sediments. The photo shows the point in the 1940's, when it was entirely forested except for the low side channels and meander scrolls of the Missouri River. At the time of the photo it was low and unprotected by any levee, with a pronounced hill and swale topography. The Kuhs levee was built in the 1960's, and is maintained as a five-year flood protection levee by the Kuhs levee subdistrict of the Consolidated North County Levee District. The Department of Natural Resources is a member of that levee subdistrict, with obligations to maintain the levee on its property

and repairs breaches. Breaches have frequently occurred, and are responsible for the three scour holes on the park. Others have been filled to restore the farm ground, one as recently as 2003.

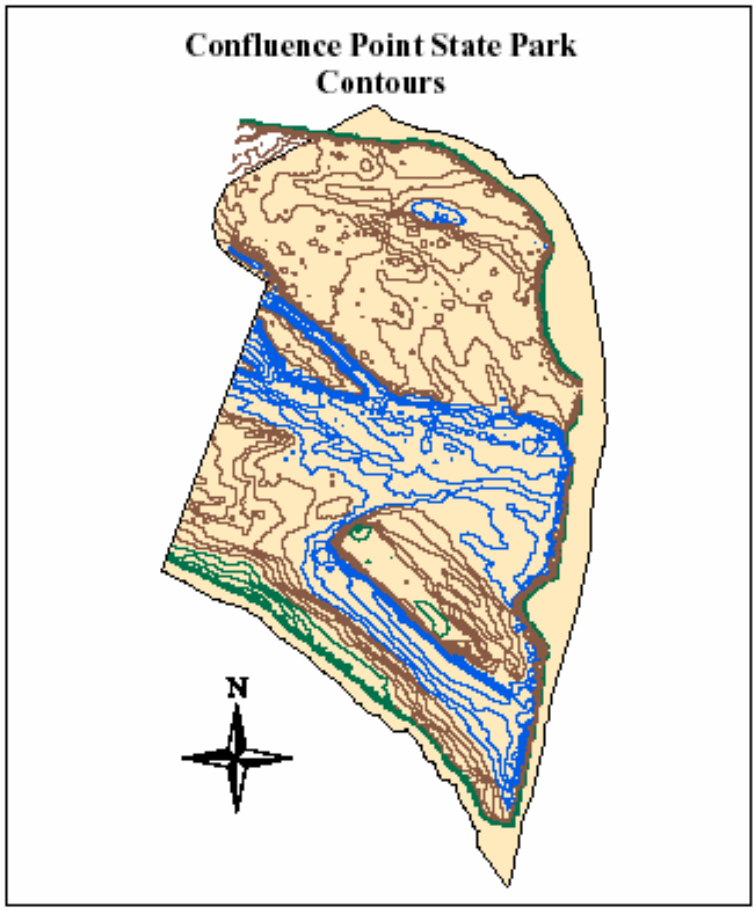
According to Melvin Neustadt, whose family has farmed the part of the property through its modern history, the land was cleared for farming beginning in the 1950's. Clearing was progressive over a period of years, and by the end of that decade the property was entirely open and farmed. Also beginning in the 1950's, underground pipelines were laid across the property. Eleven underground pipelines and a major aboveground high-voltage electric transmission line presently traverse the park.

The 1,118-acre property was conveyed to the Department of Natural Resources in parcels (see Confluence Acquisition Documents, MDNR files, for details). The 532 acres in the north is leased from the Great Rivers Greenway, while the balance is owned in fee by the Department. Each of these parcels are farmed, with several agreements regarding the tenure of farming rights for each. Thus timing of the restoration activities described in this plan depend on when each parcel of land is available for re-vegetation. Flexibility exists to extend the farming agreements until each area is ready for restoration to begin.

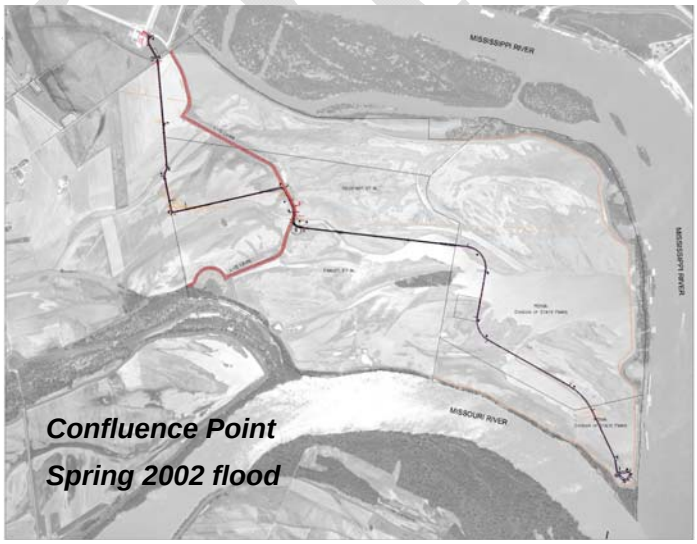
Modern Physical Environment

1) **Topography:** The Jones-Confluence Point State Park spans the distance between the main channels of the Missouri and Mississippi rivers at their junction. Its terrain is complex, characterized by a hill and swale topography that shows the pattern of flooding and drainage patterns that generally flow from west to east. Total relief is approximately twelve feet with elevations ranging from 408 to 421 feet above sea level. A natural levee has developed along the Missouri River, and two other isolated terraces or high spots are situated internally. Contrasted to the undulating topography in the southern part of the park, a relatively large and level "plain" at the 416-417 foot elevation covers the northwest park quadrant. Several low swales traverse the property, and include the internal local drainage that flows east from the adjacent properties. One large, semi-permanent pool exists at the junction of this drainageway with the outlet to the Mississippi River. Three scour holes exist alongside the Mississippi River, where levee breaks and deep scouring occurred during past floods. Others have formed but were filled to recover the farm ground, one as recently as 2002.

An agricultural levee surrounds the property alongside both rivers, and except for three drainage tubes or when the levee is breached by flooding, there is no connectivity between the park and Mississippi or Missouri rivers. The top of this levee is at 426 feet. The banks of the rivers themselves are very steep and covered in many places by rip-rap. Channel control structures border the property, with mudflats exposed behind them at low river stages. Compared to upstream lands, this park has a low elevation relative to the normal level of the Missouri river.



All these features are easily seen in the 2002 aerial photo of the confluence.

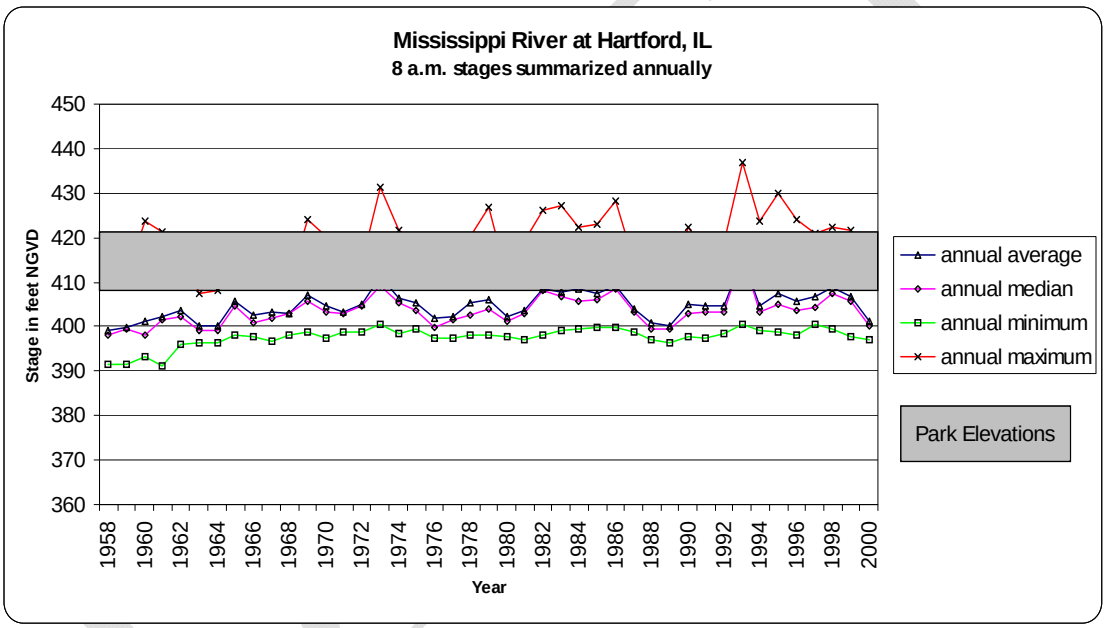


Hydrology:

Flood stage at confluence point is 417 feet, 4 feet below the highest park elevation of 421 feet. The property is protected from headwater flooding by a small agricultural levee (elevation 426'). This levee frequently breaches and there are three recent scour holes on the property where this has happened. Because the Missouri River is higher than the Mississippi, water generally mover from west to to east, through the low swales and out to the Mississippi River at three gated pipes.

The same general west- to east movement is seen when both rivers are out of their banks at the same time. The addition of a large box culvert to drain water from the opposite side of the L-15 levee will funnel more rainwater runoff onto the park than has previously occurred. Park hydrology is also influenced by groundwater connectivity between the park and river. The park has a permanent water table that fluctuates with the elevation of the rivers and some of the soils have perched water tables above the permanent water table. According to those who previously farmed the property, the groundwater connectivity is very strong and the water level inside the levee will essentially follow the Mississippi River level (M. Newstadt and M. Farley, personal communication), with a time delay of a few days.

A gage is located immediately across the river from Confluence Point, at Hartford, Illinois. This gage provides a very accurate record of river stages at the point since 1958. These stages essentially reflect the inundation patterns that would occur if the Kuhs Levee did not exist, or at times when the levee is breached or overtopped.



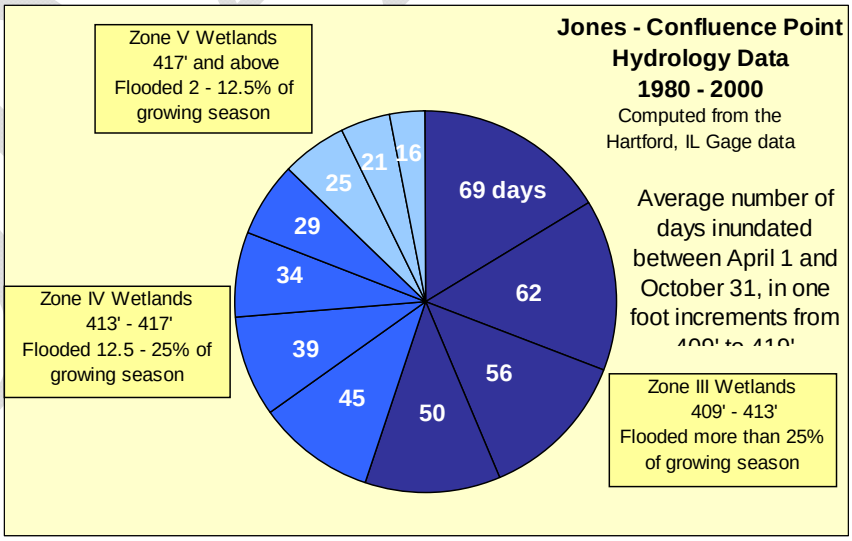
Because sand lenses allow for groundwater continuity through between the park and the rivers, river stages above 409 feet normally result in water ponding inside the park There is a time lag though, as illustrated in the graph below between river stage and water depth in a levee-protected section of floodplain. <Insert groundwater movement graph> For rapid river rises and falls below 426 feet therefore, the park will not likely be flooded to a corresponding depth, or as frequently as stage data implies. However once flooded the clay soils will hold water after the river goes down, and therefore have a wetter hydrograph than the river stage data predicts. Rainfall, surface runoff from adjacent properties and subsurface water movement from west of the park are also significant in giving a wetter park hydrology than river stage data predicts. Therefore while the following hydrological analysis uses stage data as the most solid reference by which to judge potential flood patterns and

wetland zones within the park, the final potential vegetation map must also consider these additional hydrologic variables as well as topography and soil properties.

The mean Mississippi River elevation from 1963 (when the chain of rocks low-water dam was built) to 2000 was 405 feet. This lies just below the lowest park elevation of 408 feet. The highest recorded level was 436.9 feet on August 1, 1993; the lowest (since the chain of rocks low-water dam), 395.9 feet on February 29, 1964. The average river stage has ranged from a low of 399' in 1958 to a high of 415' in 1993. The annual minimum stage has ranged from 391' (1958) to 401' (1973, 1993 and 1997), and the annual maximum stage from 407' (1963) to 436' (1993).

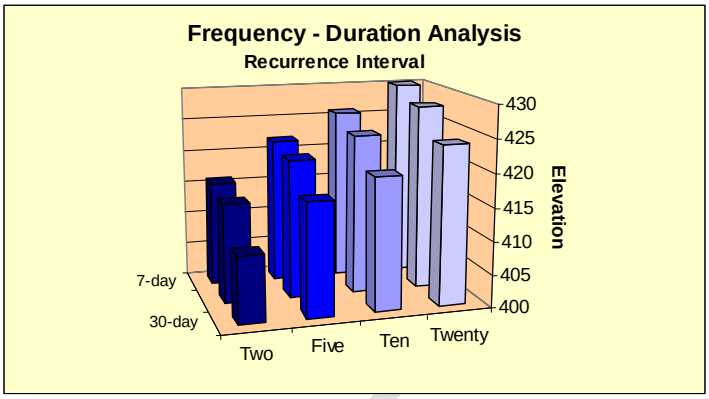
The gage records show that the park is low relative to the river stages. The annual average river stage usually runs only a few feet below the lowest park elevation, and the annual minimum daily stage is normally within 10-12 feet of the lowest park elevation. The annual maximum stage has reached park elevations in all but two years since 1958, and has exceeded the highest park elevation in 19 of those years, or 37 percent.

Understanding that the park floods frequently and has both permanent and perched water tables, certain aspects of its hydrology help determine the relative suitability for different kinds of vegetation. Particularly important is the percent of the growing season that a particular point is inundated or saturated during the growing season, and the frequency, timing and duration of the individual flood events.



Based on USDA data for St. Charles County, the growing season (days having a 50% probability of a temperature of 28 degrees F. or greater, which is the standard typically adopted by wetland regulators) runs 215 days from March 31 through November 1. Using river stage records from 1980 to 2000, park elevations below 413 feet have been under water a cumulative total number of days that average of more than 25 percent of the growing season each year. These would be classified as temporarily flooded Zone III wetlands (Mitsch and Gosselink, 1986). Park elevations between 413' and 418' are drier, having been inundated a cumulate total of days that averages from 12 – 25 percent of the growing season. These elevations would be classified as seasonally flooded Zone IV wetlands. Park elevations above 418' have been inundated for a cumulative total of days that

average less than 12 percent of the growing season. They would be categorized as temporarily flooded Zone V wetlands (see Appendix 3, Inundation Patterns). Zone five classification would only apply to the natural levee and a few internal high spots. From this twenty-year period of record and a March – September growing season, approximately 40% of the park (inside the levee) is Zone III wetland, 50 % is Zone IV, and 10 % is classified as Zone V wetland based on the hydrology.



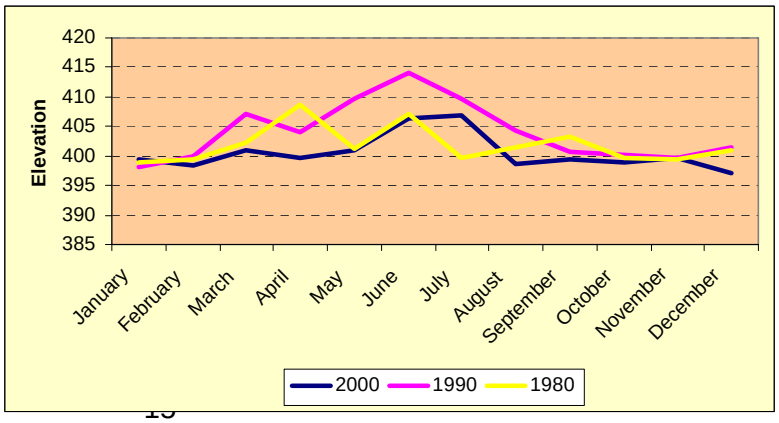
More important to vegetation patterns than merely how many total days an area floods, is how long the water stays after each event. Flood duration probabilities for the growing season are illustrated in the frequency/duration charts below. At two year intervals below 417 feet, the park should be expected to be continuously inundated for at least seven days; and for a full thirty days below 410.7 feet. Thirty days of continuous inundation should be expected to reach 417 feet once every five years, and sixty continuous days once every twenty years. Based on this history of river stages, the park should be expected to be entirely covered with water for seven continuous days every five years, for 14 days every five years, for thirty every ten years, and for sixty continuous days once in 100 years.

Somewhat different flood duration data is obtained if gage data from 1958 – 2000 is used, which causes the recurrence interval classes to drop 1or 2 feet in elevation. This causes a substantial change in the area and elevations designated for the different wetland zones, and a much broader expanse where hardwood trees or wet prairie plants would be expected to survive.

{Insert Frequency-Duration Analysis Chart, 1958-2000}

{Insert Frequency and Flooding Duration Probability Chart, 1954-2000}

The third important hydrology component is the timing of flooding. This is especially important in determining what types of flood-sensitive vegetation are best adapted to particular elevations. Using 1980,



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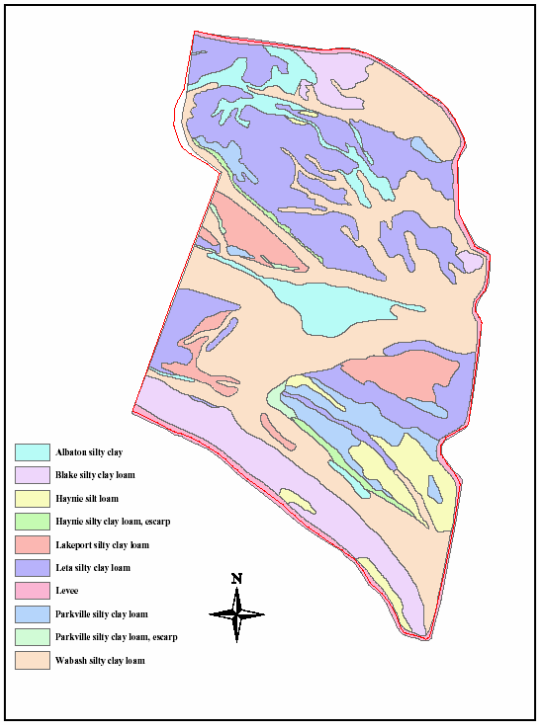
1990 and 2000 as representatives, the hydrograph below shows the typical annual flood pattern. The high river stages tend to occur from April to July each year, while river stages are typically at their lowest from August through February.

In summary, the park is low in elevation and floods frequently. All but the highest points in the park could be expected to flood most years, and at least once every ten years this water should be expected to cover most of the park for at least thirty consecutive days during the growing season. This happens even though it is protected by an agricultural levee from Mississippi and Missouri river floods, because the park lies close to the permanent water table and there is subsurface connectivity that causes the water level or soil saturation inside the park to reflect Mississippi river levels. Saturation continues even after the river declines due to the presence of high clay soils and perched water tables, and may be added to by rainfall or drainage from west of the L-15 levee.

2) **Soils:** Soil characteristics play a big role in wetland dynamics, by affecting internal drainage through their texture, clay mineralogy and structure. The soil may either facilitate drainage, which would favor bottomland hardwoods and wet or wet-mesic prairie species; or they may stay saturated or ponded long after a flood receeds. Soil permeability, texture and structure will be a major determinate of natural community targets for revegetation.

Soils at Confluence Point all formed from recent alluvial deposits. They are low in elevation, frequently flooded with perched and permanent water tables that fluctuate with the elevation of the river. Drainage is somewhat poorly on the soils of the natural levee and mid-elevation soils, and poorly and very poorly in the deep and heavy clay soils of the low swales. Seven soil series occur at the confluence. The Wabash and Albaton series have a high clay content in the upper 60 inches or more of the soil profile and occur at the lowest elevations. Leta and Lakeport soils have a high clay content from 20 to 60 inches thick, with loamy soil material below these depths. They occur on the mid-elevation sites. The Parkville and Haynie soils are dominated by silty and loamy textures throughout and are on the highest areas. Blake soils have variable textures and occur on natural levees.

Confluence State Park Soils



A major portion (497 acres) of the park is covered by Wabash, Lakeport and Albaton soils, which occur in the lowest elevations, are frequently flooded and somewhat poorly to poorly drained. Of

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these three soils, the Albaton occupies the very lowest swales and surface drainageways across the property. Both the Albaton and Wabash series are frequently ponded in spring and part of the summer, and with their thick clay layers are especially well suited to excavations for more permanent water bodies. The second most extensive (243 acres) soil series is Leta, which is clayey over loamy at mid-elevations and somewhat poorly drained. These soils but also low and poorly drained and would be suitable for shallow, marsh-like depressions and wet prairie restorations. The flat plain at 416-417 feet that covers the northwest part of the park is mostly Leta soils. The Parkville, Blake and Haynie soils are slightly higher, including the present and former natural levees. They are less frequently flooded, and somewhat better drained than the soils over the rest of the park.

The following descriptions summarize the soils, their characteristics, hydrology and the types of vegetation they support. Relative rankings of the soil types for several key attributes are found in Appendix 3, Soils.

Albaton silty clay loam (38 acres): A very deep, very poorly drained river floodplain soil, formed in recent clayey alluvium. Slopes range from 0 to 1 percent. It occurs at the lowest elevations and is saturated during November-June in most years within 0 to 6 inches of the surface. Depressional areas have up to 1 foot of water above the surface for long periods during late winter and spring in most years and after heavy precipitation. Permeability is very slow and surface runoff is negligible. Flooding is frequent for brief to long periods from February to November. Native vegetation for the type location is wet prairie.
A horizon: silty clay (40-60% clay, <5% sand); Bg horizon: silty clay loam or silty clay (45-60% clay, <5% sand); C horizon: clay (50-60% clay, < 5% sand). A mollic epipedon >40" thick is present.

Blake silty clay loam (106 acres): A very deep, stratified, somewhat poorly drained river floodplain soil, formed in recently deposited calcareous silty alluvium. Slopes range from 0 to 5%. This unit occurs adjacent to the river at mid elevations. A zone of saturation is present at depths of 1-3 feet from November-June in most years. Permeability is moderate and surface runoff is low. Flooding is frequent for brief to long periods from February to November. Native vegetation for the type location is wet-mesic to mesic prairie.
A horizon: Silt loam, silty clay loam or loam (18-35% clay, <40% sand); C horizon: silt loam or silty clay loam but individual strata range in texture from very fine sandy loam to silty clay (10-35% clay, less than 15% sand). A mollic epipedon <10" thick is present.

Haynie silt loam (58 acres): A very deep, stratified, moderately well drained flood plain soil, formed in calcareous alluvium. Slopes usually range from of 0 to 3% but range from 3 to 8% on escarpments. This unit occurs as remnant loamy deposits near the highest elevations. A zone of saturation is present at depths of 3 to 4 feet from November-June in most years. Permeability is moderate and surface runoff is low to moderately high on escarpments. Flooding is frequent for brief to long periods from February to November. Native vegetation for the type location is mesic tallgrass prairie.
A horizon: silt loam, very fine sandy loam, silty clay loam (15-30% clay, 18-55% sand); C horizon: silt loam or very fine sandy loam, but some pedons contain strata, less than 5 inches thick, of fine sandy loam and loamy fine sand (15-18% clay, 18 –80% sand). Haynie has a ochric epipedon less than 10" thick.

Lakeport silty clay loam (101 acres): A very deep, somewhat poorly drained floodplain soil, formed in calcareous silty alluvium. Slopes range from 0 to 2%. A saturated zone occurs within a depth of 1-3 feet during November-June of most years. Permeability is slow in the upper part and moderately slow in the lower part. Runoff is low. Flooding is frequent for brief to long periods from February to November. Native vegetation for type location was wet or wet-mesic prairie.

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A horizon: silty clay loam or silty clay (32-50% clay, <20% sand); Bg horizon: silty clay loam or silty clay (35-50% clay, 10-20% sand); C horizon: very fine sandy loam, silt loam, loam, but some pedons contain strata, less than 5 inches thick, of fine sandy loam and loamy fine sand (15-25% clay, 18 %-80 sand). A mollic epipedon >40" thick is present.

Wabash silty clay loam (358 acres): A very deep, somewhat poorly drained river floodplain soil, formed in recent clayey alluvium. Slopes range from 0-1%. It occurs at lower elevation than the Blake and Haynie soils and slightly higher than the Albaton. A saturated zone occurs within a depth of 6" to 1 foot during November-June of most years. Permeability is slow and runoff is very low. Flooding is frequent for brief to long periods from February to November. Native vegetation for type location was wet prairie.
A horizon: silty clay or silty clay loam (35-50% clay, 1-5% sand); Bg horizon: silty clay loam or silty clay (35-50% clay, 10-20% sand); C horizon: silty clay or silty clay loam (35-60% clay, less than 5% sand). Some pedons have very fine sandy loam and silt loam textures below 40 inches. A mollic epipedon >40" thick is present.

Parkville silty clay loam (54 acres): A very deep, stratified, somewhat poorly drained river floodplain soil formed in recent clayey and loamy alluvium. Slopes usually range from of 0 to 3% but can range from 3 to 8% on escarpments. It occurs at similar to slighty lower elevations as the Haynie soils. A saturated zone occurs within a depth of 3 feet during November-June of most years. Permeability is slow in the upper part, and moderate in the lower part. Runoff is slow to moderately high on escarpments. Flooding is frequent for brief to long periods from February to November. Native vegetation for the type location is mesic tallgrass prairie.
A horizon: silty clay or silty clay loam (27-45% clay, <15% sand); C horizon: silt loam, loam, very fine sandy loam or very fine sand (5-25% clay, 15-90% sand) and typically has thin strata of finer or coarser-textured material in the lower part of the control section. Parkville has mollic epipedon 10-20" thick.

Leta silty clay loam (243 acres): A very deep, stratified, somewhat poorly drained river floodplain soil formed in recent clayey and loamy alluvium. Slopes range from 0 to 2%. It occurs at slighty lower elevations compared to the Parkville and Haynie soils. A saturated zone occurs within a depth of 1 to 3 feet during November-June of most years. Permeability is slow in the upper part, and moderate in the lower part. Runoff is slow. Flooding is frequent for brief to long periods from February to November. Native vegetation for the type location is mesic or wet-mesic tallgrass prairie.
A horizon: silty clay or silty clay loam (27-45% clay, <15% sand); Bg horizon: silty clay loam, silty clay (27-45% clay, <15% sand); C horizon: silt loam, loam, very fine sandy loam or very fine sand (5-25% clay, 15-90% sand) and typically has thin strata of finer or coarser-textured material in the lower part of the control section. Leta has a mollic epipedon 20-40" thick. It is very similar to the Parkville series, but clayey to a greater depth.

Modern Potential Natural Vegetation:

The vegetation of river floodplains forms complex patterns that are linked to dynamic combinations of elevation, soils and flooding. The physical environment is very demanding and often changes location and extent through successive flood cycles. Floodplain plants must be either highly specialized, very resilient or quite mobile compared to upland systems. They tend to group with other species that are adapted to particular soil properties or flood patterns, and thus form definable associations that are called natural communities. Within its general characterization of very low, frequently flooded and poorly drained recent alluvium, Confluence Point supports nine distinct natural communities according to the Missouri Natural Areas Committee's Terrestrial Natural Communities of Missouri. A 1908 thesis titled "An ecological cross section of

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the Mississippi River in the region of St. Louis, Missouri" (Hus, 1908) gives further and very local detail about the composition of these natural communities prior to the dams and extensive levees that constrain the modern rivers. Another 1903 thesis titled "An ecological comparison of some typical swamp areas" by Samual Coulter surveyed Horse-shoe Lake, an old Mississippi River oxbow lake also in the American Bottoms. They are summarized below.

1. **Riverfront forest:** Poorly structured forest with trees of variable height and age classes gowing on recent alluvial deposits of silt, sand and organic debris. It is found in overflow areas adjacent to floodplains, on natural levees and ridges in a floodplain, on inside meanders and point bars of major rivers, and bordering river channels. Riverfront forests are influenced by deep headwater flooding every one- to three years that causes scouring and sediment deposition, with soil saturation or inundation for 10-20% of the growing season, most years. Dominant trees are silver maple, cottonwood, green ash, American elm, river birch, box elder, and hackberry. Shrubs and vines are common, including Virginia creeper, raccoon grape, wild grape, poison ivy, gray and swamp dogwood. Characteristic plants include sandbar and peach-leaved willow, trumpet creeper, wood nettle, tall nettle, goldenglow, clearweed, late goldenrod, white crownbeard, tall bellflower and bloodleaf.

   On the Missouri side, Hus described a riverfront forest that was luxurient but not rich in species. The soil was formed of alluvial deposits of heavy loam mixed with sand, and colluvium from the nearby uplands. The community was squeezed into a narrow band above bedrock and between the river and bluffs, higher than the floodplain in Illinois. Willows and cottonwood, with small river birches were the main tree growth, and they formed a thick hedge alongside the river. Behind it, they formed a small close-ranked woods covering four-fifths of the bottom. He called this a "park landscape in miniature." Smaller willows and river birches formed a shrub layer among which raccoon grape (*Ampelopsis cordata*), pepper vine (*Ampelopsis arborea*), grayback grape (*Vitis cinerea*), winter grape (*V. vulpina*), riverbank grape (*V. riparia*) and red grape (*V. palamata*) and poison ivy (*Toxicodendron radicans*) were numerous. Sometimes the wild grapes entirely covered their support, while wild cucumber vine (*Ecinocystis lobata*), hedge bindweed (*Convolvulus sepium*) and climbing buckwheat (*Polygonum scandens*) twine among the bushes. In spring a mat of vegetation covers the ground. Listed were mousetail (*Myosurus minimus*), small-flowered crowfoot (*Ranunculus abortivus*), marsh buttercup (*R. septentrionalis*), creeping buttercup (*R. repens*), sheperd's purse (*Capsella bursa-pastoris*), Nasturtium obtusum, nodding chickweed (*Cerastium nutans*), long-leaved stitchwort (*Stellaria longifolia*), dwarf St. John's wort (*Hypericum mutilum*), yellow wood sorrel (*Oxalis stricta*), common evening primrose (*Oenothera biennis*), wild chervil (*Chaerophyllum procumbens*), corn salad (*Valerianella radiata*), golden ragwort (*Senecio aureus*), spreading spurge (*Euphorbia humistrata*), dandelion (*Taraxacum officianale*), self-heal (*Prunella vulgaris*) and nodding wild onion (*Allium cernuum*). The most important sedges and grasses were soft fox sedge (*Carex conjuncta*), meadow sedge (*C. granularis*), blister sedge (*C. vesicaria* [= *monile*]), green bulrush (*Scirpus atrovirens*), water foxtail (*Alopecurus geniculatus*), Virginia wild rye (*Elymus virginicus*), white grass (*Leersia virginica*), barnyard grass (*Echinochloa crus-galli*) and prairie cordgrass (*Spartina pectinata*). Many of the herbaceous species are those associated with very wet or saturated ground, with individual rose mallow (*Hibiscus lasiocarpus*) and blue flag wild iris (*Iris versicolor*) standing out here and there; and different species of *Polygonum*, particularly water smartweed (*P. amphibium var. stipulaceum* [= *hartwrightii*]) cover large tracts of the higher ground. Prominent in summer and fall were white wild indigo (*Baptisia leucantha*), round-headed prairie clover (*Lespedeza capitata*), nodding bur marigold (*Bidens cernua*), tickseed sunflower (*Biden aristosa*), Joe Pye weed (*Eupatorium purpureum*), boneset (*E. serotinum*), sneezeweed (*Helenium flexuosum*), marsh elder (*Iva ciliata*), cup plant (*Silphium perfoliatum*), ironweed (*Vernonia fasciculata*), New York ironweed (*V. noveboracensis*), swamp milkweed (*Asclepias incarnata*), wood mint (*Blephilia hirsuta*), yellow giant hyssop (*Agastache neptoides*), wormseed (*Chenopodium ambrosioides*), lizard's tail (*Saururus cernuus*), different species of dock (*Rumex*) and dodder (*Cuscuta*). Goblet aster (*Aster lateriflorus*) and willow aster (*A. salicifolius* were the most prominent of the Composite (sunflower) family. Near the River des Peres, a

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few American elm and honey locust are mentioned, and swamp privet is added to the willows as predominant.

The riverfront bottoms on the Illinois side were comparable to those across the river but much broader and averaging one-half mile wide. The riverfront forest coincided with the stretches of sand bordering the river, which Hus said were only slightly elevated above river level, and also included the elevated remains of former river banks. Behind the sand was an area of heavy loam formed of old river deposits. They were covered in a broad swath of willows, mostly sandbar willow. He also included water locust (*Gleditsia aquatica*) as a not infrequent species, and referenced to occur on the confluence point opposite Alton (confluence point) as well. Individuals of *Crataegus* occurred as isolated individuals. In contrast his summary of the riverfront forest on the Missouri side, he described the low wet forest of the American Bottoms as having a rich spring and summer flora. His list included false rue anemone (*Isopyrum binternatum*), mousetail, small-flowered crowfoot, low spearwort (*Ranunculus pusillus*), velvetleaf (*Abutilon theophrasti*), yellow wood sorrel, indigo bush (*Amorpha fruticosa*), partridge pea (*Cassia fasciculata*), white wild indigo, cinquefoil (*Potentilla norvegica* and *P. rivalis*), swamp milkweed, field bindweed, blue morning glory (*Ipomea hederacea*), wild potato vine (*I. Pandurata*), small white morning glory (*I. Lacunosa*), common morning glory (*I. Purpurea*), woundwort (*Stachys palustris*), jimson weed (*Datura stramonium*), pokeweed (*Phytolacca americana*), knotweed (*Polygonum acre*), wild water pepper (*P. hydropiperoides*), curlytop knotweed (*P. lapathifolium*), lady's thumb (*P. Persicaria*), golden dock (*Rumex maritimus*), sour dock (*R. crispus*), eyebane (*Euphorbia glyptosperma*), spreading spurge and false nettle (*Boehmeria cylindracea*). He noted numerous Compositae appearing in late summer.

2. **Wet bottomland forest:** A structured forest of tall trees that is variably open depending on hydrological fluctuations and ponding. The tree canopy cover is 80-90 percent, with a sparse and poorly developed understory that often consists of scattered hydrophytic shrubs and vines. The ground cover flora is sparse and usually consists of late-season annual herbs. Wet bottomland forests are usually found around old oxbows, swales and backswamps, or seasonal depressions subject to moderate flooding of 2-3 feet nearly every year. They form in poorly drained clayey alluvium that is saturated and wet for significant periods of the year, especially the fall, winter and spring. Growing season saturation of inundation is up to 25% of the growing season most years. Dominated by pin oak, cottonwood, green ash, silver maple and black willow. Other characteristic plants include swamp privet, buttonbush, clearweed, and sedges including Gray's, bristlebract and Muskingum.

   Hus indicated that wet forests were associated with the lakes in the American Bottoms, and called them swamps. They occurred where the land was low and mainly consists of clay. His thesis indicates they were ordinarily covered with black and sandbar willows, silver maples, swamp white and pin oaks. They were shrubby in places, with possum haw (*Ilex decidua*), water locust (*Gedetsia aquatica*), buttonbush (*Cephalanthus occidentalis*) and river birch (*Betula nigra*). The herbaceous plants were abundant and mostly water-loving. The most frequently encountered spring species were small-flowered crowfoot (*Ranunculus abortivus*), southern yellow cress (*Rorippa sessiliflora*), yellow cress (*R. palustre*), water purslane (*Ludwigia palustris*), water parsnip (*Sium sauve*), butter-weed (*Senecio glabellus*), field mint (*Mentha arvensis*), mad-dog skullcap (*Scutellaria lateriflora*), blue flag wild iris (*Iris veriscolor*), sweet flag (*Acorus calamus*) and sedges. Summer flora included rose mallow (*Hibiscus lasiocarpus*), willow aster (*Aster lanceolatus* [=*salicifolius*]), Beck's water marigold (*Bidens Beckii*), gassleaf goldenrod (*Solidago gramnifolia*), great blue lobelia (*Lobelia siphilitica*), cardinal flower (*Lobelia cardinalis*), Indian heliotrope (*Heliotropum indicum*), bugleweed (*Lycopus americanus* and *L. virginicus*), wild water pepper (*Polygonum hydropiperoides*), water pepper (*P. hydropiper*), *Polygonum Muhlenbergia*, and quillwort (*Isotes melanopoda*). Hus recorded that swamps were plentiful in the American Bottom.

   Both Hus and Coulter describe thickets of swamp privet (*Forestiera americana*) that are virtually impenetrable and have virtually no ground vegetation. These were on low swampy ground near natural lakes.

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3. **Wet-mesic bottomland forest:** Intermixes with wet bottomland forest along major river floodplains, on higher rises and terraces. Characterized by tall and massive trees that form a dense, 100% closed canopy cover, with a well developed understory tree layer interspersed with more open areas, and many vines that grow well into the tree canopy. The ground layer vegetation is frequently robust and diverse. This community is also frequently flooded by shallow backwater floods every 2-5 years, with surface water present for 12-20 percent of the growing season and most of the fall through spring. Water is usually gone by the end of the growing season, although soils may remain wet or saturated below the surface well into the growing season. It is formed over deep silty and loamy alluviums that are well to somewhat poorly drained. Compared to the other forest types, it is fairly rich and diverse with a more dominant hardwood tree component. The canopy is dominated or characterized by bur oak, pin oak, pecan, green ash, slippery elm, swamp white oak, cottonwood, and shellbark hickory. The understory layer includes deciduous holly, poison ivy, wild grapes, raccoon grape, and trumpet creeper. Dominants in the ground layer include wood nettle, clearweed, false nettle, jewelweeds, swamp buttercup, white woodland aster, smooth ruellia, goldenglow, yellow ironweed, boneset, skullcap, late goldenrod, wood reed grass, fowl manna grass, cut-leaved grape fern, and several sedges, including Gray's, hop, muskingum, squarrose, crowfoot and Frank's.

   On the Missouri side of the Hus study, this forest community occupied a higher terrace just above the riverfront forest, still within his "wet bottom" designation. He described the soil as heavy loam several feet thick, covered in organic matter. He listed slippery elm, oaks (chiefly swamp white, bur and pin), walnut, butternut and bitternut hickory and several species of hawthorne as the occupying trees. He only found two pecan trees.

   On the Illinois side the wet-mesic bottomland forests formed a second and higher zone behind the willow-dominated riverfront. This probably coincides with the area of heavy loam soil that occurred "back of the stretches of sand". From remnants of what he called the "wet bottom" he listed bitternut hickory, pecan, pin oak, swamp white oak, bur oak, honey locust, kentucky coffee tree, hackberry, American elm and river birch as the most common trees. Vines were "most numererous" and included Virginia creeper (*Parthenocissus quinquifolia*) and wild grapes (*Vitis cinerea*, *cordifolia* and *riparia*). He specifically noted that the spring flora was limited to small-flowered crowfoot (*Ranunculus abortivus*), shepard's purse (*Capsella Bursa-pastoris*), spring beauty (*Claytonia virginica*), green dragon (*Arisaema Dracontium*), Jack-in-the-pulpit (A. atrorubens), *arrowhead (Sagitaria engelmanniana*), water plantain (*Alimsm Plantago*), *Carex granularis* and *Carex laxiflora*. Late season listings only included wild lettuce (*Lactuca ludoviciana*), abundant wild senna (*Cassia marilandica*), cardinal flower and great blue lobelia.

   Hus also recorded dry sandy bottoms on the Illinois side that were lower than the clayey bottoms in St. Louis county but higher than either of the forests previously mentioned. This land lay over sandy soil that largely lacked recent river deposits, and was populated by trees that were much less water tolerant than the species listed previously. He observed a rich and diverse flora that was rich in sedges and other Cyperacea, Leguminosae, Crucifera and Compositae; beneath scarlet oak (*Quercus coccinea tinctoria*), shingle oak (*Q. imbricaria*), bur oak (*Q. macrocarpa*) and chinquapin oak (*Quercus prinoides*. These drier forests were mostly gone as he did his 1907 survey.

4. **Shrub swamp:** Floodplain depressions that are shallowly or deeply flooded for most of the growing season each year, and filled with clumps or scattered thickets of buttonbush, swamp privet and ringed by black willow. They are characterized by abundant open water when flooded, and a sparse or absent ground cover consisting of rooted emergent, submergent or free-floating aquatic vegetation. Annual herbs, sedges and grasses dominate shallow margins or mud flats during dry seasons, particularly late summer and fall. Shrub swamps are a characteristic feature of large river floodplains, normally occupying overflow channels and previous main river channels.

   Henri Hus categorized these as "Sloughs" and noted that they were filled with a number of water-loving plants and always bordered by herbs and a few trees and shrubs. Water locust (*Gleditsia*

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aquatica), Kentucky coffee tree (*Gymnocladus canadensis*), buttonbush (*Cephalanthus occidentalis*) and river birch (Betula nigra) were the principle woody plants, along with occasional black willows (*Salix nigra*). Water parsnip (*Sium suave*) and cattail (*Typha latifolia*) were the common deep-water emergents, with arrowhead (*Sagittaria latifolia*), water plantain (*Alisma plantago*), bulbous bittercress (*Cardamine bulbosa* [= *rhombode*a]) and lizard's-tail (*Saurarus cernuus*) frequent in shallow water. The wet banks grew water cress (*Nasturtium officinale*), marsh yellow cress (*Rorippa palustris* [=*islandica*]), ditch stonecrop (*Penthorum sedoides*), tooth-cup (*Rotala ramosior*), false pimpernel (*Lindernia dubia*), fog-fruit (*Lippia lanceolata*), winter scouring rush (*Equisetum hyemale* {= *robustum*]) and several species of knowtweed (*Polygonum*). Floating primrose willow (*Jussieua repens*) ran out over the water and in places formed continuous bands up to six feet wide.

Species that Hus mentioned for lakes that might occur in shrub swamps included rose mallow (*Hibiscus lasiocarpus* and *H. militaris*), species of pondweed (*Potamogeton*) and spikerush (*Eleocharis*), fragrant water lily (*Nympheaa odorata*), and American lotus (*Nelumbo lutea*).

5. **Marsh and lake:** Floodplain depressions in deep, poorly drained soil that are shallowly flooded for most of the growing season each year, and dominated by herbaceous emergent, rooted aquatic and floating vegetation. Plant cover is variable but normally dense, with strong zones and patterns created by areas of dominance by different species. The dominant vegetation differs depending on average water depth, from sedge-dominated wet meadows, to bullrush and cattail dominated shallow marshes, to water lily and water lotus dominated deep marshes and lakes. They are especially characteristic of depressions in the wet prairies that are periodically burned. Marshes will develop or be restored in areas that are reasonably stable and free from heavy sediment deposition, often over perched water tables.

   Deep depressions in poorly drained floodplain soil often hold water throughout the year for most years, although they usually draw down somewhat to expose mudflats in late summer and fall. By Coulter's description American lotus and occasional water lilies were the typical deep-water plants and they grew furthest from shore. River bullrush (*Scirpus fluviatilis = S. maritimus*) was the prominent water margin plant, and extended for 40 or 50 feet up the marshy shore intermixed with floating primrose willow and spikerush species. Softstem bulrush (*Scirpus validus = Schoenoplectus tabernaemontani)* was present but less common. Broadleaf arrowhead (*Sagittaria latifolia = S. variabilis*) followed the shoreline along with beggarticks (Bidens frondosa), and duckweed (*Wolflia, Lemna* and *Spirodela*) were common. The higher shoreline was richly herbaceous with sedges being the most abundant plant form. Clearweed was very abundant among them, along with false nettle, *Polygonum Muhlenbergia*, , spreading dogbane (*Apocynum androsaemifolium*), rose mallow and indigo bush. Bordering this zone and about six inches higher in elevation a shrub and tree margin began that was bordered by eastern bluestar (*Amsonia tabernaemontana*), buttonbush and sandbar willow. Peach-leaved *willow (Salix amygdaloides*) and river birch were the most characteristic shrubs behind this border, with climbing buckwheat (*Polygonum scandens*) and wild bean (*Apios tuberosa* and *Strophostyles palustrus*) twining through them. The most common ground flora was mistflower (*Eupatorium coelestinum*), with tall thoroughwort (*Eupatorium altissimum*) and daisy fleabane (*Erigeron annuus*) secondary. Also note Hus's description of floodplain lakes in the Historic Vegetation section.

6. **Wet prairie:** A type of prairie dominated by cordgrass and a variety of flood-tolerant sedges and other plants that occurs on deep, low and poorly drained soils of large river flooplains. Soils are typically silt loam at the surface with clayey subsoil. They are often saturated with a seasonally high water table, and frequently flooded for short to moderate periods in the winter and spring. They may be briefly inundated after heavy summer rains or floods. The dominant plants are prairie cordgrass, a variety of sedges including Emory's, Short's and white-scale, and perennial knotweed. Other characteristic plants include buttonbush, false indigo, willow aster, small white aster, panicled aster, false nettle, ironweed, sawtooth sunflower, wild iris, seedbox, winged loosestrife, false aster, water parsley, woundwort, bugleweed, dogbane, marsh elder, sedges including hop, fox, sawbeak, bull and fescue-sedge, spike rushes, wild millet, rice cutgrass, fowl manna grass, great bulrush, other rushes, Canada wild rye, lance-leaved loostife, knotweeds, wild madder, stiff bedstraw and swamp agrimony. Depending on elevation and soil drainage, wet bottomland prairie vegetation ranges from a strong

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grass-dominated component to patchy grasses among sedge meadow and shallow marsh plants. It requires fire to persist, and does not tolerate heavy sedimentation.

7. **Wet-mesic prairie:** Intermixes with wet prairie, occupying higher elevations that flood less and have better drainage. Compared to wet prairie, typically has a slowly permeable soil layer that is higher above the average water table. Soils are variable, but often of silt loam surface layers with clay in the upper and lower subsoil. Depending on soil properties and flood exposure, this community will have less cordgrass and other characteristic wet prairie species. The dominant and most visible grasses will include big bluestem, Indiangrass, bluejoint grass, switch grass, and there will be a rich assortment of sedges. The large list of forbs includes sawtooth sunflower, bunch flower, lousewort, lance-leaved loosestrife, Ohio spiderwort, smooth beard's tongue, rattlesnake master, Culver's root, sweet black-eyed Susan, tall gayfeather, water hemlock, groundnut, New England aster, bushy seedbox, winged loosestrife, compass plant, white indigo, false dragonhead, monkey flower, golden Alexanders, panicled aster and cowbane. Requires periodic fire to develop and persist, and does not tolerate heavy sedimentation.

8. **Sandbar/mudflat:** Sparsely and irregularly vegetated alluvial deposits of sand, silt or mud that are exposed when water recedes alongside the river channel and in scour channels, scour holes and seasonally flooded water bodies; or newly deposited by floods and levee breaches. During the spring and early summer they are normally covered by water, but gradually become exposed when water levels drop after floods or during the summer and fall dry season. Their perimeter is usually covered in thick young growths of cottonwood, sycamore, sandbar willow and black willow; and water hemp. Between these trees and the water line will be bands of herbaceous vegetation, much of it being annuals or adventives, that is thickest and most mature on the ground that has been the longest out of the water. Characteristic species include sand grass, sand dropseed, red sprangle top, sand bur, sand love grass, creeping love grass, pigweed, bugseed, cottonweed, spurge, knotweeds, umbrella sedges, Indian heliotrope, and spreading yellow cress. Newly germinated cottonwood and elm seedlings are also abundant. This is the native environment for the federally endangered decurrent false aster, *Boltonia decurrens*.

   For mudflats comprised of shifting silt accretions, Henri Hus found sandbar willow (*S. longifolia*) and cottonwood (*P. deltoides*) seedlings numerous. Spring flora was absent due to high water. Other plants he listed were shepard's purse (*Capsella Bursa-pastoris*), balloon vine (*Cardiospermum halicacabum*), tooth cup (*Rotala ramosior*), floating primrose willow (*Jussieua repens*), giant ragweed (*Ambrosia trifida*), nodding bur marigold (*Bidens cernua*), larger bur marigold (*B. laevis* [= *chrysanthemoides*]), swamp beggar ticks (*B. connata*), daisy fleabane (*Erigeron annuus* and *E. strigosus*), horseweed (*E. canadensis*), Joe Pye weed (*Eupatorium purpureum*), boneset (*E. serotinum*), autumn sneezeweed (*Helenium autumnale*), marsh elder (*Iva ciliata*), inland marsh fleabane (*Pluchea camphorata*), jimson weed (*Datura stramonium*), horse nettle (*Solanum carolinense*), black nightshade (*S. nigrum*), hedge hyssop (*Gratiola virginiana*), monkey flower (*Mimulus alatus*), purslane speedwell (*Veronica peregrina*), fog fruit (*Lippia lanceolata*), knotweed (*Polygonum hydropiper* and *P. hydropiperoides*), awned nutsedge (*Cyperus aristatus*), low nutsedge (*Cyperus diandrus*), salt meadow grass (*Diplachne fasicularis*), creeping lovegrass (*Eragrostis reptans*) and horsetail paspalum (*Paspalum fluitans*).

   For sandbar islands that were exposed in fall by lowering river levels, Hus says that young tree seedlings were common, along with jointed rush (*Juncus nodosus*) and slender rush (*J. tenuis*), low nutsedge (*C. diandrus*), straw-colored nutsedge (*C. strigosus*), water cress (*Nasturtium officinale*), marsh yellow cress (*Rorippa palustris*), blunt-leaved yellow cress (*R. obtusa*), giant ragweed, wormseed (*Chenopodium ambrosioides*), were the principle plants near the water and the first to make their appearance when the water receeded. Where the islands were higher and exposed long enough for plants to get a permanent foothold, he found sandbar willow formed dense thickets along with peach-leaved willow, numerous liverworts (*Riccia natans*), beggar lice (*Desmodium paniculatum*), jimson weed, black nightshade, awned nutsedge, Schweinitz's nutsedge (*Cyperus Schweinitzii*) and rusty nutsedge (*Cyperus odoratus* [= *speciosa*]).

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9. **River bank:** A narrow and variable community found on the steep banks of the floodplain directly above the Missouri and Mississippi river channels, outside the river levees. The soil is a mixture of sand, silt and clay overlain by stone rip-rap in most cases at Confluence Point. The vegetation is zoned, beginning with shrubs and herbs at the river level to trees on the high embankments. Vines are prevalent and sometimes prolific, particularly wild grape, raccoon grape and wild cucumber vine. Cottonwood, sycamore, silver maple, box elder, black willow and green ash are the typical trees, and many will arch or lean out over the river. A large mixture of herbaceous plants occur, variably distributed from sparse to robust depending on light availability. The river bank is directly subject to flooding and the force of the current, which often undercuts or erodes it. Beaver frequently cut and feed on the trees.

   Coulter recorded vegetation for an old river shoreline alongside Horseshoe Lake. He found immense sycamores, cottonwoods and red maples towering above a dense undergrowth of yellow birch (river birch? = *Betula lutea*), peach-leaved willow (Salix amygdaloides), swamp privet (*Forestiera acuminata*), slippery elm, green ash, green hawthorne, rough-leaved dogwood (*Cornus asperifolia*) and honey locust (*Gleditsia triacanthos*). The prominent vines were bur cucumber (*Sicyos angulata*), riverbank and grayback grape (*Vitis riparius* and *cinearea*) and poison ivy. False nettle, rattleweed (*Astragalus canadensis*), common evening primrose (Oenothera biennis), and giant and common ragweed (*Ambrosia trifida* and *artemisiifolia*) were the herbaceous plants he listed as common.

   Hus reported that for the in-channel mudflats along the Missouri shoreline that were exposed below the bedrock layers in summer and fall opposite the American Bottoms, the very lowest elevations were occupied by short-pointed nutsedge (*C. acuminatus*), low nutsedge and autumn fimbry (*Fimbristylis autumnalis*). A belt of tickseed sunflower (*Bidens aristosa*) grew a little higher, followed by small sandbar willow, cottonwood and river birch seedlings. The highest zone also included abundunt slender spike rush, marsh and blunt-leaved yellow cresses, crane's bill (*Geranium carolinianum*), white sage (*Artimesia ludoviciana*), iron weed (*Vernonia fasciculata*), water pimpernel (*Samolus parviflorus*), common morning glory (*Ipomea purpurea*), black nightshade, narrowleaf paleseed (*Conobea multifida*), fog fruit, water hemp (*Amaranthus tuberculatus*), sour dock (*Rumex crispus*), knotweeds (*Polygonum aviculare, P. hydroprperoides* and *P. Persicaria*), wild lettuce (*Lactuca canadensis*), prickly lettuce (*L. scariola*) and Queen Anne's lace (*Daucus carota*).

   The sandy shoreline of the American bottoms was scantily vegetated when Hus did his botanical survey. Sandbar willow and cottonwood were always present, with a sequence of herbaceous plants through the year. He lists common evening primrose (*Oenothera biennis*), cocklebur (*Xanthium canadense*) and large-bracted plantain (*Plantago aristata*) as characteristic; and prostrate knotweed (*Polygonum aviculare*), erect knotweed (*P. erectum*), several nutsedges (*C. acuminatus, C. aristatus, C. diandrus, C. Schweinitzii, C. oderatus* and *C. strigosus*) were present. Marsh and blunt-leaved yellow cress, common flax (*Linum usitatissimum*), crane's bill, tick trefoil (*Desmodium cuspidatum* and *D. paniculatum*), alsike clover (*Trifolium hybridum*) and common mullien (*Verbascum thapsus*) were fairly numerous. The most important late-season composites were white sage, swamp beggar ticks, tickseed sunflower, nodding bur marigold, Joe-Pye weed and boneset; with occasional jimson weed, horse nettle and black nightshade, prairie three-awn grass (*Aristida oligantha*) and poverty grass (*Sporobolis vaginiflorus*). In some places wormseed (*Chenopodium ambrosiodes*) completely dominates, in others smooth scouring rush (*Equisetum laevigatum*) is common.

Native vegetation models: Three Missouri State Natural Areas (Missouri Natural Areas Committee, 1996) exist in the area, to serve as examples from which to assess the plant species and communities of native natural riverfront environments similar to Confluence Point. All three are islands, two in the Mississippi (Lincoln County) and one in the Missouri (St. Louis County). These have similar hydrology and soils, and are considered by the Missouri Natural Areas Committee to represent the best remaining examples of mature native riverfront and bottomland forest communities in the region. High quality

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examples of wet prairie are very rare, but there are a few examples in the Missouri Natural Area System and the marshes and wet-mesic prairie communities that are normal inclusions within them, from which to model species composition and structure.

1. **Pelican Island Natural Area:** Pelican Island is a 1000 acre island in the Missouri River about eight miles upstream from Confluence Point. Like it, in 1819 this location was mostly river channel except for two small sand and debris islands exposed at its present location (see historic channel map, appendix a). Today it comprises soils (Blake-Eudora-Waldron), topography and development history very similar to Confluence Point; with extensive and mature wet, wet mesic and mesic bottomland forest. The wet bottomland forest (Waldron soils) is low in diversity and dominated by silver maple, poison ivy and black willow. The wet-mesic forest is similar, but with a more developed understory that includes sting nettle and abundant cottonwoods in the overstory. Hackberry, green ash, sycamore, rough-leaved dogwood and silver maple dominate the mesic forest on the higher and better-drained Eudora soils (Missouri Natural Areas Committee, 1983).

2. **Westport Island Natural Area:** Westport Island is a large Mississippi River island about 40 river miles above Confluence Point. A 420-acre portion has been designated a Missouri Natural Area, for its large and undisturbed old-growth bottomland forest with sloughs and shrub swamps. It was also identified in the U.S. Army Corps of Engineer's GREAT III Natural Area Study as having the best floodplain forest structure in the inventory region. Like Confluence Point, the soils are deep, poorly drained floodplain soils; but of the Colo series. Silver maple, cottonwood, sycamore, pin oak and pecan in the overstory dominate wet and wet-mesic forests here. Elm, green ash, box elder, hackberry, honey locust and mulberry is also present. Common understory plants include deciduous holly, swamp privet, poison ivy, grape, greenbriar, raccoon grape and trumpet creeper. A large variety of herbaceous plants cover the higher ground, while the lowest ground has very sparse ground vegetation. Stinging nettle, false nettle and a variety of woodland grasses and sedges are particularly abundant. Many of the oaks and pecans died in the 1993 flood. The sloughs are dominated by black willow, green ash, swamp privet, buttonbush, poison ivy, smartweeds, arrowhead and duckweeds. (Missouri Natural Areas Committee, 1984)

3. **Prairie Slough Natural Area:** Prairie Slough is a riverfront floodplain located just upstream of Westport Island on the Mississippi River. Soils are of the Westerville-Fatima-Wabash association, which are deep, nearly level moderately well drained to very poorly drained loamy and clayey floodplain and terrace soils. The 406-acre Natural Area features old-growth wet and wet-mesic bottomland forest and slough. The wet bottomland forest is dominated by pin oak, cottonwood, silver maple and pecan, with river birch, black willow and sycamore also common. Shrubs and vines are abundant in the ground cover. These include swamp privet, deciduous holly, poison ivy, wild grape, raccoon grape and trumpet creeper. The wet-mesic bottomland forest is dominated by shellbark hickory and pin oak, but there is a high canopy diversity including bur oak, pecan, sycamore, persimmon, hackberry and

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honey locust. Understory shrubs and vines are common, including deciduous holly, hawthorne, spicebush, wild grape, green briar, trumpet creeper and poison ivy. Herbaceous ground cover is very thick and abundant, dominated by stinging nettle, spotted touch-me-not, bellflower and poison ivy. Shrub swamps occur in the sloughs and depressions, that are seasonally wet but often dry during summer and fall. Buttonbush and Ward's willow occur in clumps or dense patches, seperated by soil or open water, with duckweeds commonly floating on the surface. Knotweeds and spanish needles are common in fall. (Missouri Natural Areas Committee, 1987)

4. **Locust Creek Natural Area and Pershing State Park:** Upstream from the Missouri River floodplain in north-central Missouri, on a tributary of the Grand River, this park contains one of the two large wet prairies left in Missouri. It forms a rare model of a natural, wet prairie ecosystem in a large river floodplain. Prairie cordgrass, multiple sedges including Short's and Emory's, bluejoint grass, stout woodreed, whitegrass, rice cutgrass and wild rye dominate the wet prairie. Dominant and characteristic forbs include white beard's tongue, Virginia wild iris, woundwort, and Indian hemp. Seasonally flooded depressions within the wet prairie are mostly filled with shallow marsh vegetation, including buttonbush, hardstem and river bullrush, arrowhead, water parsnip, water plantain, bur-reed, perennial knotweed and water hemlock. Higher elevations that are flooded for shorter periods contain wet-mesic prairie, with a vegetation that more closely resembles the typical tallgrass prairie. A mixture of big bluestem, Indiangrass, switchgrass, bluejoint grass and prairie cordgrass dominate this community. There is also a much wider diversity of forbs than found in the wet prairie. Common among them are sawtooth sunflower, compass plant, tall gayfeather, rattlesnake master, white beard's tongue, false dragonhead and white wild indigo.

5. **Other vegetation models:** Well preserved native natural vegetation is an exception anywhere in the Missouri or Mississippi river floodplains of Missouri. Besides the natural areas described above, good quality remnants of native floodplain communities may be found at Oumissourit Marsh Natural Area (Saline County), Little Bean Marsh Natural Area (Platte County), and Oval Lake and Bur-reed Slough Natural Areas (Pike County).

Part Two: Restoration

Goal: To restore the natural communities and native vegetation of a frequently flooded low riverfront ecosystem. This will be a predominantly forested landscape that follows the hill and swale topography on the site, with seasonally flooded sloughs and marshes in the low swales and scour channels. It will include wet prairie, bordered by groves of pin oaks. These vegetation types will be restored or facilitated according to the different wetland zones and soil types at the park.

Wetland Zones: Soils, hydrology and vegetation patterns coincide to form recognizable wetland zones, which generally correlate with the surface elevations or topography.

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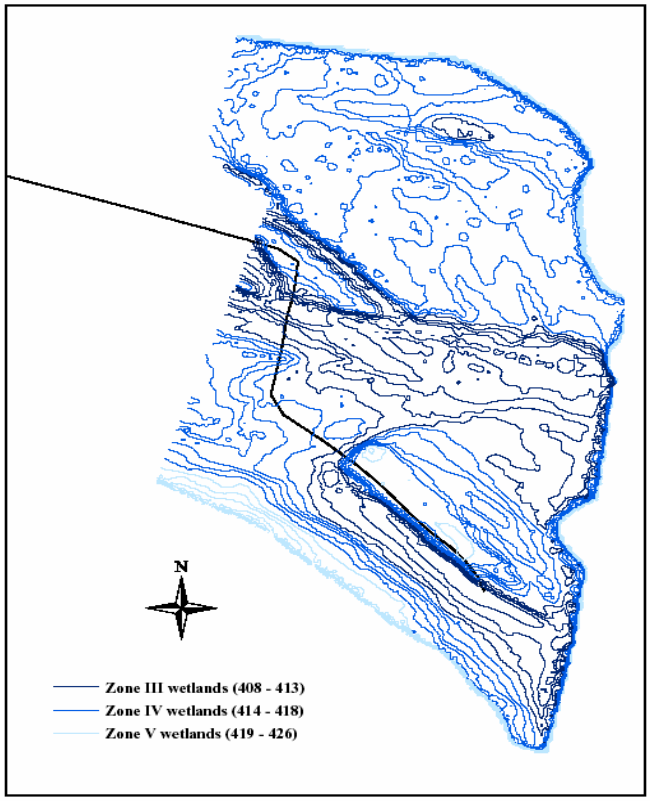
Wetland zones are often used to associate wetland characteristics and functions to relative elevations (Larson et al. 1981 and Cowardin et al, 1979). In the case of Confluence Point where no native vegetation remains, wetland zones can be used to predict the natural communities for which the flood patterns are best suited, and tie these to specific park elevations. Soil types will further match natural community types to specific elevations and locations within these zones.

Based on the last 20 years of flood stage data at the Hartford, Illinois gage, detailed soil maps and a high resolution surface map, four wetland zones currently exist (adapted from Mitsch and Gosselink, 1986; and Taylor, Cardomone and Mitsch, 1990). These are described below, with the natural terrestrial community associations described by the Missouri Natural Areas Committee.

Confluence State Park
Wetland Zones



{Insert wetland zones map}
{Insert wetland communities chart}

Zone I wetlands are open water that is continuously flooded. No such hydrologic condition presently exists at Confluence Point.

Zone II wetlands are intermittently exposed (flooded essentially every year for most of the growing season), a hydrology that currently only applies to the scour holes along the Mississippi side of the property. It could also apply to depressions or excavations on perched water tables, and the deep drainage swale through the center of the property. Depending on soil type, the suitable potential natural communities include shrub swamp, marsh and sandbar/mudflat.

Zone III wetlands have a hydrology described as semipermanently flooded (51-100 % of years, with the total duration of flood events typically more than 25% of the growing season). Soils are dominated by dense clays, and a lack of oxygen prevails for much of the year. In the pioneer stage that exists at Confluence Point, they support adventive vegetation such as black willow, sandbar willow, silver maple and cottonwood. These often grow in monospecific stands on new point bars and alongside scour channels. At Confluence Point Zone III wetlands occur below 413', mostly in the Albaton, Wabash and portions of the Blake and Lakeport silty clay loams. The suitable potential natural

communities are Riverfront Forest, and the wettest versions of Wet Bottomland Forest and Wet Prairie. Over perched water tables the Zone III wetlands could occur at higher elevations and also include shallow marsh and low wet prairie species.

Zone IV wetlands are seasonally flooded (51-100% of years, for 12.5-25% of the growing season). At Confluence Point they occupy the elevations between 413' and 417', and include soil types Blake, Lakeport, some Wabash, Leta, Parkville and most areas of Haynie. Their soils are alternatively aerobic and anaerobic depending on the prevailing flood condition. Clay soils dominate, but coarser material may be present. Forested versions support a wider variety of trees including American elm and green ash, besides those mentioned for Zone III. Above 416' on Leta soils, pin oak and swamp white oak would be expected. Cordgrass-dominated wet prairie occurs in Zone IV, where associated with Leta soils and frequent fire.

Zone V wetlands are described as temporarily flooded (11-50% of years, for 2-12.5% of the growing season). Their soils are dominated by silt loams, silty clay loams and very fine sandy loams that are only briefly flooded and therefore much better suited for root respiration. They support wet-mesic forest or prairie depending on the fire regime, and in both cases the vegetation is more species rich and diverse than in any of the other zones. This zone would be tolerant and supportive of bottomland hardwood restoration, or praire that includes big bluestem and other typical prairie species. At Confluence Point Zone V wetlands only occupy the very small portion of the park that sits higher than 417'. These are the Blake, Haynie and Parkville soils of the long natural levees that parallel the Missouri River. The suitable potential natural communities include Wet-Mesic Forest and Wet-Mesic Prairie.

Revegetation Model:

The revegetation model is one that largely matches the existing landform and physical environments with suitable native plant communities. The intent is for the park to have a very natural look that reflects the examples offered by Missouri Natural Areas and other old-growth natural ecosystems along the Missouri and Mississippi rivers, yet recognizes the dynamic nature of floodplain ecosystems and the modern alterations of the rivers and their floodplains.

When completed, the park's natural environment will be predominately low riverfront forest dissected by seasonal wet depressions and drainages. The Missouri River will be bordered by a high natural levee with groves of hardwoods, while the relatively high, but poorly drained "plain" to the northwest will be covered in wet prairie with groves and borders of pin oak flats. The prairie will be interspersed by marshes occupying shallow, seasonally inundated depressions. Cottonwoods, willows and silver maples will dominate all the low elevations, except where water stands long enough each year to cause ponds that dry into mudflats and scrub-shrub wetlands through the summer.

{Insert Potential Vegetation map}

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The restoration potential map provides a general idea of the vegetation patterns that will be targeted through restoration at Confluence Point. The locations are based on suitability for the wetland zones at the park. These vegetation targets assume that the hydrology as presented from the 20-year Hartford gage data accurately models park hydrology, and that the L-15 drainage or other changes in inundation patterns do not significantly alter the wetland zone designations. Towards these restoration goals and achieving these revegetation targets, the following five restoration objectives are established with specific strategies or actions.

Restoration Objectives:

1. Fulfill the 404 Permit Requirements for a 10-acre mitigation wetland, and other obligations
2. Facilitate revegetation of the natural communities
3. Provide for permanent and semi-permanent pools
4. Provide for fish access between the river and the park
5. Manage the federally listed endangered species, and other rare or conservative species
6. Establish biological inventory and monitoring

Restoration Objective #1: Fulfill Section 404 permit requirements for a 10-acre mitigation wetland, and other activities.

A 10-acre wetland cell has been constructed at the location noted below, in 2003. This is designed to function as a low elevation seasonal pond, that will expose a sandbar/mudflat natural community as water recedes in the summer. It will include low hummocks of soil to increase the opportunity for the federally endangered Boltonia decurrens to colonize and survive. It is to be surrounded by a buffer planted to native vegetation, to reduce sediment runoff and erosion into the wetland. Because most of the area surrounding this wetland is Zone III wetland category, with soil and hydrology that supports a riverfront natural community dominated by cottonwood, willow and silver maple, no active planting needs to be done. These areas were removed from agriculture in 2003. They should be lightly disced in spring 2004 just prior to the cottonwood seed release. On the west side, pin and swamp white oaks should be planted on the higher ground between the wetland cell and park boundary.

Other 404 permit activities involving the Boltonia decurrens and the bald eagle nest are described in the appropriate objective below.

Restoration Objective #2: Facilitate revegetation of the natural communities characteristic of a large river, riverfront environment.

This includes the:

Forested natural communities

<u>Wet-mesic bottomland forest:</u> Re-establish a forest that includes a mixture of pin oak, bur oak, swamp white oak, pecan and bitternut hickory on the high natural levees in the south end of the park. This will be above 418 feet in areas of Blake, Haynie and Parkville silt

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loam. Limit plantings of this species combination to the Zone V wetlands, which are inundated less than 10% of the growing season. Based on the gage data, this zone will be flooded for seven continuous days of the growing season about every third year, continuously inundated for thirty or more days about once every ten years, and be flooded for sixty days perhaps once each 20 years on the average. Sow native Virginia wild rye (Cuivre Island origin) as a cover crop, and mow between the seedlings for the first five years. After the seedlings are well established, cease mowing and allow silver maples, cottonwoods, willows, elms and hackberries to establish naturally around and among them. Maximum area of wet-mesic bottomland forest that includes these hardwood species will be approximately 70 acres. Note that a 60-100 foot wide corridor must be kept tree-free alongside the levee, to provide room for borrow material to be collected for levee maintenance.

High wet bottomland forest: Plant groves and areas of pin oak and swamp white oak around the prairie and on the more elevated areas of Leta silty clay loam on the high elevation Zone IV and V wetlands between 416 to 418'. These will be inundated an average of 9 to 16 percent of the growing season, and experience over thirty days of continuous inundation about once every 4 to 10 years. Seven days of continuous growing-season inundation may be expected every one- to three years. Sixty days of continuous inundation happens every 15 to 20 years. As with the wet-mesic forest plantings, sow Virginia wild rye as a cover crop and mow between the seedlings for the first five years. After that, allow other tree species to natural establish within the planting areas. As indicated in the potential vegetation map, tree planting should also concentrate at the western park boundary to provide a screen between the wet prairie and private land. Groves of trees should be planted within the wet prairie, and along its margins. Include a few plantings of water locust (*Gledetsia aquatica*) which was also native to this location. High wet bottomland prairie suitable for pin oak and swamp white oak exist on approximately 132 acres, but tree plantings will be limited by the funds and staff available for this reforestation.

Low wet bottomland forest: Promote natural regeneration of cottonwoods, willows, elms, ashes and silver maples on the more frequently flooded Albaton, Wabash, Lakeport, and some Haynie, Leta and Blake soils of the low elevation Zone IV wetlands below 416 feet. This will be in locations inundated for an average of 24 – 34 % of the growing season, with thirty consecutive days of flooding every two- to three years, and seven continuous days of inundation almost every year. Facilitate this natural regeneration by progressively removing strips of land from agriculture, preferably beginning near the levees to take advantage of the nearby natural seed sources. Disc the ground prior to seed rain, to capture the natural seed fall. No planting should be needed for these species. Approximately 350 acres of low wet bottomland forest is expected, although the extent will be variable according to river stages and flood flows.

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Riverfront: The wet bottomland forest will grade to a riverfront natural community at the lower park elevations. Its exact boundary may shift from wet to dry years, which influences the duration of flooding at low park elevations and its affect on the ability of trees to survive or mature. Approximately 207 acres of riverfront community are expected inside the levees, plus a natural riverfront community already exists alongside both the Mississippi and Missouri rivers. No restoration or establishment is necessary.

Sandbar/mudflat: The restoration target at the lowest elevations of Zone II wetlands below 413' is young shrub-scrub wetland (Cowardin, 1979). These hold water through the spring and early summer, but slowly dry through the summer to create extensive mudflats. They will develop naturally over the lowest elevation Wabash and Albaton soils, which normally hold water for 25 to 40 percent of each growing season and experience over thirty days of continuous inundation nearly every other year (at 410 feet). A thick hedge of cottonwood, willow and river birch should be expected at the high margins of this community, with seedlings of same sprouting on newly dried soil. Water locust plantings would be appropriate as well. Approximately 62 acres of sandbar/mudflat community is mapped, although the exact extent depends on seasonal river stages and flood flows. This community will also occupy the 10-acre mitigation wetland at the west end of the property, and it already exists in the three scour holes along the Mississippi levee.

Wet prairie: Establish wet prairie on high elevation Zone IV and V wetlands from 416 to 418'. This will be on the high plain in the northwest quadrant of the park, over Leta silt loam soils. This is a heavy clay soil that corresponds to the swamp societies described by Hus (1908). The area is flooded from 12 – 16 percent of the growing season on the average, and inundation of over 30 consecutive days during the growing season may be expected every 4 - eight years. Seven days of consecutive growing season inundation occur every other year. Prolonged flooding for 60 days might happen once in twenty years. Wet prairie will also span several natural swales within this zone, which are slightly lower elevations and comprised of Wabash and Albaton silty clay loams. Wet prairie may also be established along utility corridors that must be kept free of trees. These prairies are to be dominated by cordgrass and other wet prairie species as described in the natural community section. Wet mesic species may be included on high spots within the prairie above 418'. Wet prairie is planned for occupy approximately 133 acres.

Wet prairie will be started by distributing native wet prairie hay, collected in late summer for the cordgrass seed and late spring for the sedge, cool season grass and early wildflower seed. Pershing state park or other more local native wet prairie may serve as the donor. The planting sites will need to be mowed at least once each summer to control tree colonization during the establishment period, and a prescribed fire program will be required once a fuel structure develops. Once the dominant matrix grasses have established, continue enriching the site with appropriate wet prairie species for the area with hay mulch, and planting seed or rootstock.

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Marsh and shrub swamp: Reestablish herbaceous marsh and also shrub swamp communities within the wet prairie and high wet bottomland forest areas, in natural or created depressions that hold water from rainfall or backwater flooding on perched water tables over the clayey Leta, Wabash and Albaton soils. These correspond to Zone II and Zone III wetlands, although this hydrology exists at higher elevations compared to the rest of the park due to the perched water tables. Many of the sedges and broadleaf plants will colonize naturally, but planting by seed or rootstock of both the common matrix and the more unusual but characteristic species will be necessary. It will be especially important to mow the marshes annually to control tree growth, until the herbaceous vegetation is re-established and dense enough to support periodic fire. An option exists to create some marsh and slough areas by building low berms that span the low swales that drain the Leta plain in the northwest part of the park.

Other revegetation:

1. Plant a 100' wide strip of wild rye around the perimeter of the property, and maintain this by mowing until other forest or prairie plantings take place high elevation Zone IV Wetlands from 416 to 418'. This is to serve as a weed buffer against private agricultural land on the west boundary, and allow access and borrow areas for levee repair elsewhere.
2. Control Johnsongrass by mowing and herbicide application throughout the revegetation process.
3. Unless specifically referenced in this plan or approved by the Natural Resource Management Section, no plant species that is not native to the area and normal for the natural community in which it is to be placed, will be used in any of the restoration work. Strong preference will be given to obtaining native plant materials grown from locally obtained stock, to the extent they may be feasibly obtained.

Restoration Objective #3: Provide for both deep and shallow semi-permanent pools, in a natural and normal configuration for a large river floodplain.

1. Explore possibilities to create shallow vernal pools and ponds (Zone II wetlands) in the Albaton and Wabash soil areas that are oriented parallel to the current and designed to replicate the cross section and appearance of natural scour-created pools. These will be shallow and sinuous, with the most likely location being alongside (but above and outside of) the main drainage channel. Consider these for both forested and prairie environments, and be given a natural rather than engineered appearance. Mowing and plant introduction will be needed to provide for their natural appearance and diversity, particularly those in the prairie area.
2. Develop a marsh-bordered shallow lake by placing a berm across the mouth of the two drainage channels flowing off the east side of the proposed wet prairie on the east-central part of the park. Manage the shoreline for development of a strong perennial vegetation, which will include planting or facilitating colonization of characteristic lakeside plants and mowing until enough herbaceous cover establishes to support management by the fires from the adjacent prairie. This shoreline should be rich in sedges and perennial herbs, with a prominance of bullrushes and

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spikerushes in the deeper water. Include additional shallow (8" deep) basins uphill of the larger lake within the same drainage channels.

3. Excavate at least one deep, permanent pool (Zone I wetlands) that follows the contour of the lowest existing terrain. This pond should be designed to hold water most or all of the growing season, and be connected to the Mississippi River during high water periods so that it can harbor fish throughout the season and help meet Objective 3, below. Further soil investigations will be needed to find locations with deep enough clay in the drainage swale for one or more of these excavations.

For both kinds of excavations, introduce characteristic emergent marsh species, particularly the sedge, forb and bullrush species that will not easily colonize on their own. While the initial plantings of dominant marsh species should be planned to take place early in the restoration, adding diversity by introducing other characteristic or even rare plants must be a long-term, on-going process. These kinds of depressions are logical places to spread seed of the *Boltonia decurrens* (also see Restoration Objective 4, below). It will be very important to prevent or control tree colonization with annual or periodic mowing, while this herbaceous vegetation is establishing. Where open water or depressional wetlands occur near the exposed powerlines, protection for the birds who will be attracted to the water should be designed.

Restoration Objective #3: Provide for connectivity to the Mississippi River, and movement of fish to and from the riverside wetlands and pools.

There are 91 species of fish that live in the lower Missouri river (USACE, 2003), and they are adapted to an abundance of backwater and side channel habitats. Many of these reproduce in the seasonal pools and waterbodies of the adjacent floodplain, even though they may spend most of their lives in the river. Fish will normally move into the floodplain during the high water conditions of spring and early summer, and back out again as the pools dry up in late summer or fall. Their presence in seasonal floodplain pools is not only important for reproduction, but it attracts a variety of fish-eating birds and mammals. This includes ospreys, eagles, four kinds of herons, five species of grebes, pelicans, kingfishers, terns, gulls, cormorants and egrets. Restoring connectivity between major rivers and providing floodplain spawning habitat is a major goal of fish and wildlife mitigation projects along both rivers.

The Confluence Point property is surrounded by agricultural levee, and drained through a gated pipe. Pipes are not ideal for fish movement, because of their small size and depth.

The Confluence Point restoration plan calls for considering fish weirs or other means of allowing fish ingress and egress which will not cause impoundment or drainage problems for the adjacent landowners. Fish weirs are preferred, because they are very conducive to fish travel but still provide flood protection. In the case of Confluence Point, they must not impede drainage from the bordering agricultural fields; nor may they impound water behind the levee, that will cause water to back onto those properties.

An alternative to fish weirs might be the installation of a large-diameter pipe, which will allow fish access to the low and excavated seepage pools. This pipe must be large

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enough for fish to readily use, and be located near the surface for the intended range of river elevations.

The restoration plan also calls for one or more excavated pools deep enough to hold water throughout the summer and fall of most years, so that fish entering the floodplain in spring may survive through to the next high water. This should be designed as a Zone I wetland in the Albaton and Blake soil below 410, near the Mississippi. It should be constructed with a natural contour and design that mimics natural floodplain scour holes. This pool may also serve as a borrow area for levee repair as needed.

Project feasibility and design studies will need to further explore how to provide for better fish access and use, without impairing drainage or flood protection for adjacent properties. The design will also need to consider the new drain through the L-15 levee that will empty onto the low swale where the fish pools will be located. Increased water flow and heavy sedimentation may need to be worked into the design.

Restoration Objective #4: Protect and manage for preservation of federal listed endangered species, and others of conservation concern

Two federally listed species are significant for restoration planning, and will need special consideration. A map showing their locations may be found in appendix 1.

Bald eagle: In 2003, a pair of eagles built a nest in a large cottonwood tree, alongside the Mississippi River about 100 yards upstream of the point. Road construction and park development was delayed through the nesting season, and the pair successfully fledged one young eagle. This may be the same pair of eagles that constructed a nest slightly upstream and across the Mississippi near Wood River the previous year. Another eagle nest was identified south of Confluence Point in St. Louis. The pair returned to the same nest in 2004, again laying eggs and maintaining the nest despite the construction taking place at the point and for the new road and parking lot.

The U.S. Fish and Wildlife Service issued a biological opinion on April 25, 2003 in which they summarized management considerations. These became requirements of the 404 permit issued by the Corps of Engineers for park road and facility development. Based on these and other recommendations by the U.S. Fish and Wildlife Service, the DNR must:

1. Avoid construction impacts and minimize human disturbance near the eagle nest.
2. Implement a public education strategy to raise awareness of eagle needs among park visitors and avoid potential for conflicts between park visitors and bald eagles.
3. Monitor eagle reproductive success at the nest and eagle movements in the project area.
4. Submit an annual report by September 30th of each year to the U.S. Fish and Wildlife Service, documenting eagle reproductive success.

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The restoration of the Confluence Point will provide abundant new eagle nesting and foraging habitat in the long run. For the present, the one nest tree must be protected from loss or damage. During the nest season, the area around the nest must be closed with signs placed to notify the public. Interpretation signs should be placed at the point itself, informing visitors of the eagles and including a protection message. Nobody, including park staff, should approach the nest during the egg incubating and chick rearing period. Park staff will need to monitor annually for use and nest success.

Boltonia decurrens: This species of false aster is a member of the sunflower family that is found on moist, sandy floodplains along or near the mouth of the llinois River. It requires periodic flooding to scour seasonal wet depressions and natural ponds, and inundate them long enough to prevent perennial plants from growing. It will be found in such depressions after the water has evaporated to expose sandy mudflats in summer. The decurrent false aster is threatened by excessive siltation compared to the prairie-protected floodwaters of its natural heritage, elimination of marshes and natural lakes in its range, and by levee construction that eliminates the scouring that once created its habitat. There are presently only 26 known native populations for this plant.

In October, 2002 nineteen plants were discovered on a low saddle between two scour holes just below the east face of the L-15 levee, approximately one mile west of the park boundary. These were situated exactly in line of the only allowable park road route, and had to be moved. The plants were relocated to a low swale near the Confluence Point (Appendix 1). Also for mitigation, approximately two 5-gallon buckets of seed were collected from two nearby locations on USACE Riverlands Project lands. This seed was distributed in the same low swale, and also on newly turned soil alongside the park entrance road. The next year, several hundred Boltonia plants flowered, and distributed seed naturally in those locations.

Once a good seed source is established, restoration of the sandbar/mudflat natural community and wet depressions within the prairies and forests should provide abundant quality habitat for this species. In order to assure its survival at Confluence Point, and in part to meet the 404 permit requirements, several actions will be taken:

1. Distribute additional seed in all newly created depressional wetlands. This includes the permit-required Mitigation Wetland, the pools and sloughs excavated as part of this restoration plan, new naturally created scour holes, and in shallow marshes and depressions created within the wet prairie. These areas will need to be mowed or disced initially, to keep cottonwoods from claiming the habitat.
2. Maintain the existing Boltonia population as a nursery colony, by lightly discing or mowing the low swale in which it was planted. All tree growth and dense perennial herbaceous growth must be prevented in this location, until several strong populations have established in restored proper habitat.
3. Monitor locations and population sizes annually throughout the property, and report annually to the U.S. Fish and Wildlife Service as required by permit.
4. Design the Mitigation Wetland to include intermediate terraces or several small islands below bank-full elevation, that will be inundated at bank-full stages but

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emerge in the summertime to provide germination opportunity. This wetland should also have long sloping sides, and an undulating (not square) perimeter to maximize edge.

Other conservative or restricted species: Just as some species of hardwood trees have been extirpated from the region or are unlikely to establish in competition with cottonwoods and willows, many species of shrubs and herbaceous plants will need to be introduced if they are to become a part of the park's flora. Some of these, like *Eragrostis reptens*, were once characteristic but are now very rare. Others, like many of the marsh and lake edge plants that may be common in natural area remnants elsewhere, still need to be started at the site before cottonwoods and willows take over if they are likely to occur. There are also a few examples of plants that were always rare or infrequent, but still a natural component of river floodplain natural communities. An important component of this plan is to identify those species, and successfully establish them at Confluence Point. The restoration will also provide environments for several rare animal species such as the western fox snake and the stinkpot turtle. Least terns are known from just off the property, and many species of rare or uncommon birds can be expected as the native vegetation returns.

Restoration Objective #5: Establish biological inventory and monitoring

Restoration is an adaptive process that requires observations of results of the actions, to allow plan or procedural modifications that will lead to the revegetation goals. Managers will need a better idea of how the water table responds to changes in river levels, and the overall hydrology patterns inside the park. Monitoring of water tables and the biota will therefore be essential to guide restoration. Surveys and inventories will also provide information for park interpretation and park visitors. For the two endangered species, it is required by the 404 permit.

1. Install peizometers immediately, to monitor the water table depth and construct a reference log prior to any restoration work. This should also capture information on water tables as they might be influenced by changes in drainage through the L-15 levee, before other work at Confluence Point progresses. This information will help determine the suitability of the revegetation plans described in this plan.
2. Install surface water level measuring devices in pooled areas, eg automatic recorders or staff gages.
3. Monitor endangered species, as mentioned above
4. Conduct periodic plant inventories
5. Establish bird sighting logs or records, within the division's Natural Resource and Information Database.

Challenges and Potential Threats

The USACE has installed a conduit through the L-15 levee, which will route runoff water from this large floodplain onto the Confluence Point property. It will empty at a second

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culvert just beneath the park entrance road. This water is all agricultural drainage that will likely pump sediment into the low central swale and seasonal wetlands. This may make the deep pool for the fisheries objective difficult or impossible to sustain, and raise the elevation of that swale. When this drainage of additional lands west of the levee is directed onto the Confluence Point property, it will also likely change the hydrograph for these lower park elevations. Because the restoration plan is based on strict hydrologic regimes that are not directly controlled or manipulated, this change in hydrograph could impact the success of restoration plans. The USACE needs to evaluate the magnitude of its impacts, and design the project to protect against sedimentation and damaging inundation.

Repair and maintenance of the agricultural levee inside park boundaries is a legal responsibility of the Department of Natural Resources. Access needs to be maintained, and borrow areas will need to be provided for its occasional repair. Once the agricultural fields have reverted to wetland vegetation, they may not be available for fill.

Johnsongrass control will be essential, both to protect neighboring agricultural interests and to prevent it from impeding revegetation or restoration of native species. Combinations of herbicide and mowing will be imperative, especially on the wet prairie and in the hardwood plantings.

Summary, with Five-year activities plan

Restoration at Confluence Point will focus primarily on revegetation of native ecosystems that are suitable for the existing soils and hydrology. It will emphasize as natural an appearance as possible, utilizing the existing soils and topography. No major water holding or delivery systems are currently planned, nor any major modifications of the floodplain. Earthwork will be limited to creating minor seasonal water bodies, with perhaps one deeper permanent water body. The only major structural modification desired is a weir or gate to allow better fish ingress and egress from the Mississippi River.

The vegetation model is for bottomland forests of softwood species to re-claim low elevations the park. The high natural levee along the Missouri, and one internal high point will be planted to groves of bottomland hardwoods of multiple species that are typical of a natural levee. Pin oak groves or belts will be planted in the north part of the park, on the high and flat ground surrounding a wet prairie restoration. Shallow depressions within this prairie will be deepened and restored to perennial marsh. The deep swales through the property will naturally revegetate as mixed woody and herbaceous scrub-shrub wetlands, with seasonal waterbodies created that will be naturally reclaimed by shrub swamp or sandbar/mudflat species including the federally-listed Decurrent False Aster. Within the deepest swale, a more permanent water body will be created to support fish and attract birds.

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The vegetation goal is to restore the natural communities and native plants characteristic of frequently flooded low riverfront ecosystems. The five restoration objectives are: 1) Fulfill the obligations of the 404 permit regarding wetland mitigation; 2) Facilitate revegetation of the natural communities; 3) Excavate permanent and semi-permanent pools; 4) Provide for fish access between the river and the park; 5) Manage the federally listed endangered species; and 6) Establish biological inventory and monitoring. For the next five years, these are the major restoration activities for Confluence Point:

1. Seek funding, either through Section 206 Continuing Authorities Program (St. Louis District) or the Missouri River Fish and Wildlife Mitigation Program (Kansas City District).
2. Plant hardwood trees alongside the south side of the entrance road, on the high ridge designated for wet-mesic forest. Sow Virginia wild rye between them and protect the new seedlings with at least an annual mowing for their first five years.
3. Plant cottonwood saplings in the disturbed area around the new parking lot, and if possible sow or start appropriate wetland sedges and grasses around them.
4. Mow the fallow ground between the 404 Mitigation Wetland and the west park boundary, and plant pin oaks and swamp white oaks in this area categorized as high wet bottomland forest. Continue mowing between them for the first five years, to hold the softwood trees in check until the hardwoods are well established.
5. Disc the fallow ground north and east of the park entrance road, just prior to the cottonwood seed release.
6. As required by the Section 404 Permit, construct low islands with long sloping sides inside the mitigation wetland that will be underwater for the early growing season, and emerge as mudflats later in the season. Seed these with *Boltonia decurrens*. Assure good vegetation around the mitigation wetland to protect it from erosion sediments.
7. Install piezometers along the western boundary, and begin routine monitoring of water table depth.
8. Continue removing 100 acres per year from agricultural production, from the land owned by DNR. At first most of this will be in the natural reforestation zone, but some will lie within the area suitable for shallow excavations which will need to be accomplished soon after abandonment. They must not develop tree or wetland vegetation before earth-moving plans are completed.
9. Prepare for planting hardwood clusters on the natural levee alongside the Missouri, as the agricultural leases expire in 2005, 2006 and 2008
10. Initiate the wet prairie restoration, by collecting and spreading wet prairie hay mulch, and mowing annually to prevent tree growth while the prairie plants are becoming established.
11. Collect and distribute Boltonia seeds into the wet swales.
12. Control Johnsongrass, whenever it appears.

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References

Bell, D.T. 1974. Studies on the ecology of a streamside forest: Compostion and distributionof vegetation beneath the tree canopy. Bulletin of the Torrey Botany Club 101:14-20.

Brackenridge, Henry Marie. 1814. Views of Louisiana; together with a Journal of a Voyage up the Missouri River, in 1811. Pittsburgh: Cramer, Spear and Richbaum.

Coulter, S.M. 1903. An ecological comparison of some typical swamp areas. 1904 Annual Report of the Missouri Botanical Garden 15:39.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. FWS/OBS-79/31. U.S. Fish and Wildlife Service, Washington, D.C.

DRAFT

Featherstonaugh, F.R.S., F.G.S. 1844. Excursion Through the Slave States From Washington on the Potomac to the Frontier of Mexico; with Sketches of Popular Manners and Geological Notices. Reprinted in 1968 by Negro Universities Press, New York.

Flint, Timothy. 1826. Recollections of the Last Ten Years, passed in occasional residence and journeyings in the valley of the Mississippi. Boston. New York: Da Capo Press reprint; 1968.

Harlan, J.D. and J.M. Denny. 2003. Atlas of Lewis and Clark in Missouri. University of Missouri Press, Columbia. 138p

Historical Records Survey. 1939. Inventory of the County Archives of Illinois, St. Clair County. Chicago, Illinois.

Hus, H. 1908. An ecological cross section of the Mississippi River in the region of St. Louis, Mo. Nineteenth annual report: St. Louis, Missouri Botanical Gardens, p. 127-258 (Reprint)

Larson, J.S., M.S. Bedinger, C.F. Bryan, S. Brown, R.T. Huffman, E.L. Miller, D. G. Rhodes, and B.A. Touchet. 1981. Transition from wetlands to uplands in southeastern bottomland hardwood forests. Pages 225-273 in J.R. Clark and J. Benforado, eds. Wetlands of bottomland hardwood forests, Elsevier Science Publishing Co., Amsterdam

Missouri Natural Areas Committee, 2003. Revised Terrestrial Natural Communities of Missouri. P.W. Nelson.

Missouri Natural Areas Committee, 1996. Directory of Missouri Natural Areas. Missouri Department of Conservation.

Nelson, J.C., Redmond, A., and R.E. Sparks. 1994. Impacts of settlement on floodplain vegetation at the confluence of the Illinois and Mississippi rivers. Transactions of the Illinois State Academy of Science, 87:3-4, p117-133.

Schroeder, Walter A. 1982. Presettlement Prairies of Missouri. Missouri Department of Conservation Natural History Series No. 2.

Stoddard, Amos. 1812. Sketches, Historical and Descriptive, of Louisiana. Philadelphia: Mathew Carey.

USACE. 2003.

Wlosinski, J.H. and L.B. Wlsoinski. 2001. Predicting Flood Potential to Assist Reforestation for the Upper Mississippi River System. Public Status Report, U.S. Department of the Interior, U.S. Geological Survey, Upper Midwest Environmental Sciences Center.

DRAFT

Yin, Y. and J.C. Nelson. 1996. Modification of the upper Mississippi River and the effects of floodplain forests. In: D. Galat and A. Frazier, eds., Overview of River-Floodplain Ecology in the Upper Missouri River Basin. Volume 3 of Science for Floodplain Management for the 21st Century, J. Kelmelis, ed.

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EDWARD (TED) AND PAT JONES

STATE PARK

SOILS REPORT

EDWARD (TED) AND PAT JONES
STATE PARK

SOILS REPORT

BY

Department of Natural Resources
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Soil Scientist IV
Department of Natural Resources

DRAFT

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CONFLUENCE STATE PARK

SOILS REPORT

In 2002 the Missouri Department of Natural Resources, Division of Parks acquired 1118 acres of land at the confluence of the Mississippi and Missouri Rivers. This land, purchased through the cooperative effort of several private and government agencies, has become known as the "Edward (Ted) and Pat Jones State Park" (the Park). It is located on the eastern tip of St. Charles County, Missouri. This area represents a small portion of the landscape and vegetative communities of the Mississippi River Valley and the Missouri River Alluvial Plain. The goal of this new park is to restore the native vegetation and natural wetland communities suitable to the site's current soil, topography and hydrologic conditions. The data put together for this report is to assist in this endeavor and to educate the public about this unique area of Missouri.

The Park is located in St. Charles County (Figure A and B), west of Hwy 367 and north of I-270. It's east of the town of West Alton and across the river from Alton, Illinois.

FIGURE A
SITE MAP LOCATION

It can be found on the Wood River and Columbia Bottom topographic quad sheets. The property is located in Township 47 North, Range 8 East, Sections 4, 5, 8 and 9.

FIGURE B
SITE MAP LOCATION

GENERAL DESCRIPTION

The Edward (Ted) and Pat Jones State Park lies on the North side of the Missouri River and the East side of the Mississippi River where the two merge. This area is nearly level to slightly undulating with a total range in elevation of 14 feet. The long axis of landforms of the Park is dominantly oriented in a West to East direction, with sloughs and drainage channels draining to the East.

The area is classified into the framework of the Ecological Classification System. This framework is a regionalization, classification, and mapping system for stratifying the Earth into progressively smaller areas of increasingly uniform ecological potentials. Divisions are made based on associations of those biotic and environmental factors that directly affect or indirectly express energy, moisture, and nutrient gradients which regulate the structure and function of ecosystems. (USDA Forest Service, 1993)
At higher levels separations are based on climate and potential vegetative differences. At midlevel, distinctions are made on stratigraphy and potential vegetation. At the lowest level differences are made on stratigraphy, landforms, soils, and potential vegetation.

Domain: Humid Temperate

Division: Interior Highlands

Province: Ozark Plateau

Section: Ozark Highlands

Subsection: Missouri River Alluvial Plain

Landtype Association: West Alton Alluvial Plain

STRATIGRAPHY

The soils of the Park are dominated by Holocene aged alluvium. In general this alluvial material demonstrates the conventional fining upward of soil particle sizes. This fining upward sequence from sand to silt to clay is a natural part of a functioning river system as it incises. As the river incises and the adjacent landforms become elevated above the water surface only finer and finer soil particles can be deposited.

Landforms and the corresponding elevation of these landforms supply a secondary control on the particle size distribution. Landforms at the higher elevations have a coarser particle size with fine and very fine sands being at or near the surface. Landforms at lower elevations have thicker silt and clay deposits with the lowest elevations having as much as 6 feet of this material.

The basic alluvial landforms from the highest elevation to lowest

are: natural levees, flood-plain steps, flood-plain step escarpments and sloughs. These landforms developed under a braided river system, unlike the levied system of today. Different soils formed on these landforms based on their elevation, shape and proximity to the river channel.

Soils dominated by sands are usually adjacent to the old abandoned river channels (sloughs). They occur on old sandbars, sand splays or river- banks. Some of these landforms are at the highest elevations of the park except for the natural levees. Silts can be found on the natural levees while clay dominates the sloughs and low lying areas were water is ponded or slow moving, allowing the clay particles in suspension to settle out. The majority of the park has either a silty clay or silty clay loam surface and upper subsoil overlying silts or sands.

The Park is in an area of continued flooding with deposition and scouring still an active part of the Parks genesis. Landforms and soils will change with time.

A block diagram illustrating the processes described above can be found in Appendix A.

SOIL GENESIS

Soil genesis is the mode of origin of the soil with special reference to the processes or soil-forming factors responsible for development of the solum from consolidated parent material (Soil Science Society of America, 1987). It can be viewed as consisting of two steps, viz., the accumulation of parent materials, and the differentiation of horizons in the profile (Simonson R.W., 1959). These are not separate or linear transactions, but merge and overlap, becoming indistinguishable with time.

Climate, organisms and hydrology combined with a specific parent material and landform determine soil horizonation. The resulting horizons are due to the combined affects of additions, transformation, transfers and removals. Both the chemical and physical properties are altered during the process of horizonation.
Soils of the Confluence State Park project and their specific properties are tied directly to the mode of deposition. The initial and ongoing intensity and duration of floodwaters over the study site determine the amount of soil genesis that can occur. Soils that are located on protected landforms above the annual flood height show more pedogenic development then those that receive annual deposition.

SOIL FORMING FACTORS

Soil formation is a dynamic and ongoing process. Soils are continually changing. Changes occur within the parameters of the ecosystem and result from diurnal or long-term fluctuations in the factors of genesis.

Hans Jenny described the modern soil profile as a product of the interactions of several environmental factors over time. These soil-forming factors, as described by Jenny and others, consist of parent material, organisms, topography or relief, climate and time. The process of accurately delineating soils in a given region begins with understanding the soil forming factors and their expression.

TOPOGRAPHY

Topography is the specific relationship of component parts of a landscape described by shape, size and position. Shape is describe by many terrain attributes including slope percent, length, convexity, concavity and uniformity. Position is described through relief and areal relationships. Combinations of these attributes can be used to recognize specific landforms. Landforms are three-dimensional parts of the land surface that are distinctive in shape, significant to landscape genesis, repeatable and consistent in position relative to other landforms. Influences on soil formation occur mainly through the affect of water and energy movement in the landscape. Shape and position in the landscape exert strong control over hydrology and moisture retention. Convexity, concavity and relative elevation affects near surface microclimate that can be seen in differences in drainage and the community of plants that evolve there. Available moisture is affected by these properties as well as the nature of a landform relative to its position in the landscape to govern the run-off, run-on, throughflow and retention of precipitation. (Rowe, J.S., 1984)

Four landforms were utilized in the mapping exercise on Confluence State Park. They are flood-plain step, flood-plain step escarpment, natural levee, and slough. Illustrations of these landforms can be found in Appendix B. An example of a floodplain step is shown below in figure C.

FIGURE C
LINEAR FLOODPLAIN STEP

PARENT MATERIAL

Parent material refers to the unconsolidated organic and mineral materials in which soil

forms (Soil Survey Division staff, 1993). Soil material, subsequent to deposition, represents a soils initial state. It has specific physical, chemical and mineralogical properties related expressly to the characteristics of the depositional material.
The Edward (Ted) and Pat Jones State Park has a range of mixed alluvial materials. Alluvium is unconsolidated material subaerially deposited by running water (USDA, 1993.). This material is dominated by stratified silt and very fine sands capped with clays.

CLIMATE

Climate is defined as the prevailing or average weather conditions of an area as determined by the meteorological changes over a period of year's (The World Publishing Company, 1978). The two most commonly measured features of climate that have been correlated to soil properties are rainfall and temperature (Buol et al. 1980), but wind is also a factor.
Climatic conditions are usually spoken of in terms of averages, which include the extremes of temperature and rainfall, as well as climatic shifts, which occur over time. As important as these averages are, it may well be that the extremes play a greater role in the development of some soil properties.

Climate is the energy source for soil genesis and is thought by many to be the most important soil-forming factor. The magnitude of climatic control on soil formation can best be seen by making comparisons that are global in scope such as soils developed under desert versus rain forest conditions. However, certain local variations in climate (microclimates) provide evidence of the influence of the climatic factor on soil formation within relatively small areas. (Buol et al. 1980)

Rain and temperature variations influence the weathering of parent material through freezing and thawing and dissolution of soluble minerals. It regulates some of the chemical and physical reactions, which take place in the soil. Wind and rain also influence the shape and distribution of landforms through geologic erosion and deposition of soil material.

The balance between rainfall and evapotranspiration affects the translocation of minerals, soil particles and acids within the soil. Higher concentrations of water can increase depth to clay and/or bedrock and the translocation of bases. Activity levels of micro and macro organisms, quantity and type of organic matter and the dynamics of chemical reactions are impacted by temperature variations and amounts of available moisture.

ORGANISMS

Organisms include the many plant and animal species, which live both on and in the soil. They are active from the onset of soil genesis, assisting in the decomposition of parent rock and organic material.

Microbes and simple plant forms colonize the initial parent material surviving on the minerals released through physical and chemical weathering, wind blown deposits or guano deposits. They add energy and substance through photosynthesis to the system. These become a source of organic matter, nitrogen and carbon and organic acids which further decomposition. As soil development continues higher plants are established, supplementing the physical breakdown of the rock. Plants cycle minerals such as nitrogen and calcium from the soils to plant tissue and back. Toxic substances are produced setting temporary limits to populations and distributions in the landscape (Buol et al. 1980). The following are affected by the plant species, and amount present: Water movement, the amounts of organic matter, minerals and nitrogen available for other organisms.

As organic matter, minerals and nitrogen increase colonization by various species of fungi, bacteria, actinomycetes, microarthropods and macroorganisms follows. Soil porosity changes as a result of organic matter additions due to the increase in bioactivity and the subsequent mixing. Water movement, effected by bioactivity, increases chemical reactions at depth in the soil. Organic acids, a product of organic matter decomposition, induce the chelation of iron which along with clay minerals, which are formed as a result of the development of secondary minerals, are moved into the subsoil. This results in soil structure and horizonation.

TIME

Time is the most elusive of the soil forming factors. It may be regarded as continuous, yet recognize a "time zero" for a particular soil. Time zero is the point at which a new cycle of soil development is initiated (Buol et al. 1980). Initiation can result from a catastrophic event such as geologic uplift, from climatic shifts or from significant deposits of new materials such as loess. Energy and material inputs began to accumulate at "time zero" and act over time producing continuous change. The time needed for property development is variable and is influenced by the other soil forming factors. In general they are acquired over a long period of time, measured in hundreds and thousands of years. (Yaalon, D.H., 1983).

The affect of time can change over the course of a soils genetic history. It allows living organisms, climate and topography to exert their

influence on parent material (Wolf D. et al., 1994). Over time a soil nears a terminal state where change is imperceptible although never ceasing. Time becomes significant again when there is a shift in the major soil forming factors, i.e.; major climatic change.

HYDROLOGY

Hydrology, including water movement across the landscape surface, into and through the soil and into and through the underlying alluvial formations is an important environmental factor of the Park due to its affect on soil genesis, as well as soil productivity.

Hydrology is difficult to characterize due to the many variables, which influence its movement and the variation of these variables over short distances. Consideration needs to be given to slope, surface morphology, horizon texture and structure, vegetative cover and depth to and continuity of the underlying alluvial deposits. These factors must be contended with in a myriad of combinations on the park property.

Rainfall either reaches the soil surface or is intercepted by vegetation. A portion of the water intercepted by the vegetation reaches the soil surface through stem flow or dropping from leaves. The remainder evaporates. Once water reaches the surface, it can enter the surface soil, evaporate or runoff.

The rate of infiltration or runoff is controlled by storm intensity (supply of water), surface texture and clay mineralogy (permeability and cracking), degree of saturation and slope. Direction of water movement and area of accumulation are controlled by surface morphology. Convexities can be considered as water losing sites while concavities would be considered as water accumulating.

Runoff occurs during intense storms mostly during leaf off periods. Due to the texture and clay mineralogy the soils of the Park have minimal infiltration especially when wet. What water does enter the surface moves vertical through pores and preferential flow channels, horizontally and vertically between peds. A percentage is stored in pores, along contacts between thin soil strata and as films on the faces of peds. This becomes available for plant uptake. The availability and amount of water affect productivity and species distribution. Excess water continues to move downward and also laterally along horizons with variable textures. This water will continue to move until it joins with the apparent water table found in these soils.

Areas of water accumulation at the base of escarpments, sloughs and on the tread of upper floodplain steps have greater

supplies of water available to plants. Whereas water losing zones, like flood-plain step escarpments and isolated high areas, have less available water for plant uptake and soil genesis.

Water tables are an important aspect of the Park and its hydrology. A water table can be described as "the upper surface of ground water or that level in the ground where the water is at atmospheric pressure (Soil Science Society of America, 1987).

Two types of water tables occur on the Park property. They are apparent water table and perched water table. An apparent water table would correspond to the surface of the permanent ground water of the site. This water table appears to be connected to the river system and fluctuates with the diurnal rise and fall of the river. Cores pulled during the period of investigation showed the apparent water table to be 7 to 8 feet below the surface.

A perched water table is "a saturated layer of soil which is separated from an underlying saturated layer by an unsaturated layer (vadose water)". (Soil Science Society of America, 1987). This zone is, in many cases, within the rooting depth of the plant species of the Park. The degree of saturation, the duration and the level below the surface will determine the amount of available oxygen for plants and species suitability. Perched water tables, more than the apparent water table will affect the distribution of plants across the landscape.

SITE DESCRIPTION

The park extends to the north and west from the confluence of the Mississippi and Missouri Rivers. It is 2.1 miles in length and slightly over 1 mile wide. The site is entirely located within the 100-year floodplain with undulating alluvial landforms and man-made drainage channels. Slopes range from .5 to 2%, with steeper slopes of up to 8% occurring on some of the flood-plain step escarpments.

Two soil orders, Mollisols and Entisols are represented on the Park. Mollisols make up the majority of the soils (82%) while the Entisols represent 18 percent of the Park.

Mollisols are typified by having a dark surface greater than ten (10") inches thick and high base saturation down to a depth of at least sixty inches. (Figure D)

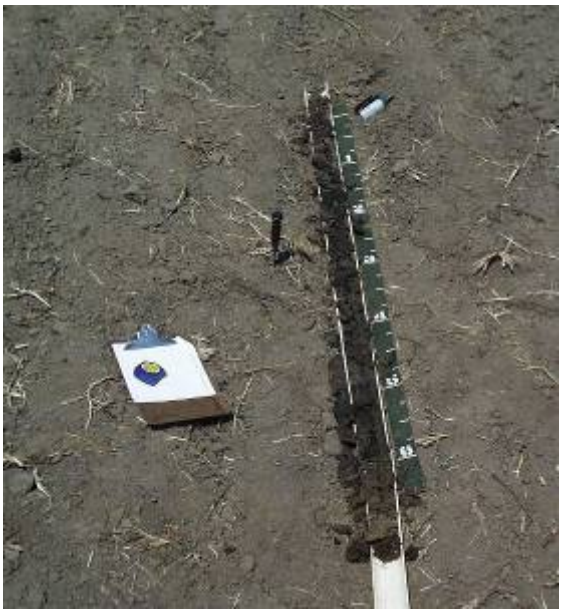


FIGURE D:
MOLLISOL PROFILE

Entisols are considered a recent soil with little or no distinguishing development. Stratification is usually within six inches of the surface.

SOIL MAPPING

Methodology

The design for mapping consisted of combining soil survey mapping techniques with a transect system of data collection. Boundaries were set for the transect lines utilizing a road, drainage ditch, levee or other natural feature for the starting and ending points. Soil Scientists were spaced at equidistances and traversed a semi-straight line between the points, crossing landforms perpendicular to their long axis and collecting data along the traverse.

Soil properties deemed important in use and management and requiring separation were drainage and family. Chemical data, important to the separation of map units, were used to equate important properties inferred during fieldwork. Taxonomy, although used to set some boundaries for properties, was not used as a means to separate soils.

Soil mapping was conducted on the Park during 2003. Aerial photographs at a scale of 1/12000 were chosen as a base in lieu of the standard 1/24000. This allowed finer resolution in the mapping, which was needed, for the research project. Map units as small as .2 of an acre were delineated.

Ten map units were designed utilizing the criteria described above. A legend listing each of the map units can be found in Appendix C. Data was collected on the each of the landforms and families. One to two soil cores were collected on each of the major soil-landform units. Additional lab data was used from a nearby study in similar soils. A location map for each pedon sampled on the Park is located in Appendix E. Samples were collected from each horizon and sent to the University of Missouri Soil Characterization Lab. Particle size, extractable bases, acidity, extractable aluminum, CEC, aluminum saturation, base saturation, organic carbon and pH were determined in the laboratory.

Ranges for these properties are given in the map unit descriptions for the surface, upper subsoil and lower subsoil.

MAP UNIT DESCRIPTIONS

A detailed soil map of the Park occurs in Appendix D of this report. Each unit is designated with a symbol, which represents a given set of properties including parent material, landform, slope and soil properties. Each designation is presented in the legend in Appendix C. A cross section of these map units as they relate to parent materials, landforms and soil series can be found in Appendix A and B.

The map unit descriptions in this section, along with the detailed soil maps, legend, pedon descriptions and lab data Appendix F can be used to determine the suitability and potential for forest and wildlife management. The following tables are organized by the numerical designations of the map units and list ranges of soil properties for each unit. Chemical and physical properties are from lab data collected from backhoe excavations and cores.

MAP UNITS & LAB DATA

[1] – The Haynie map unit consists of very deep, calcareous, moderately well and well drained soils on flood plains. These soils formed in calcareous alluvium.

Important soil properties of this map unit:

<u>Parent material</u>:
Alluvium

<u>Slope</u>:
0 to 2 percent

<u>Particle size</u>:
Surface, 20 to 71% silt
15 to 27% clay
Subsoil, 1 to 45% silt
6 to 45% clay

<u>Surface thickness</u>:
Minimum, 8 inches
Maximum, 14 inches
Average, 12 inches

<u>Thickness of clay:</u>
No clay within 60"

Available water:
Upper 40 inches;
6.0 to 8.8 inches

Drainage:
Well drained and
Moderately well drained

Depth to bedrock:
>60"

Base status: cmol (+) kg-1
Surface, 15.0 to 37.0
Subsoil, 15.0 to 50.0

CEC: cmol (+) kg-1
Surface, 17.0 to 23.0
Subsoil, 4.0 to 33.0

Clay mineralogy:
Smectitic

Sand mineralogy:
Mixed

Aluminum saturation:
Surface, NA
Subsoil, NA

Organic matter:
Surface, 1.16 to 2.26%
Subsoil, .16 to 1.66%

Base Saturation:
Surface, 79 to 100%
Subsoil, 87 to 100%

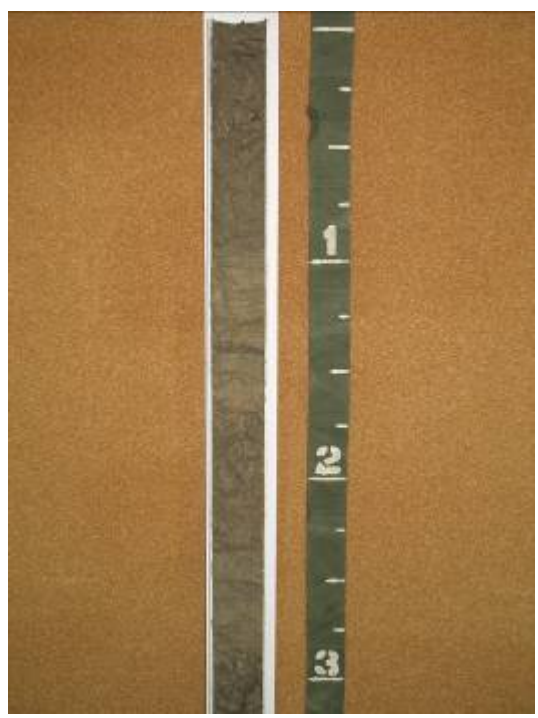
pH:
Surface, 6.0 to 7.9
Subsoil, 6.8 to 8.2

This map unit occurs on the higher landforms within the interior of the park. The units range from 0.5 to 22.5 acres in size.

Typically the surface layer is very dark grayish brown, silt loam, clay loam or very fine sandy loam from 8 to 14 inches thick. The subsoil is greater than 60 inches thick. It is dark grayish brown or very dark grayish brown silt loam to fine sand in the lower part.

The Haynie series was used to represent this map unit. Lab data from this unit was variable. This variability should not affect the use and management.

[2] – The Parkville map unit consists of very deep, calcareous, somewhat poorly drained soils formed in clayey over loamy alluvium on large flood plain steps. Permeability is slow to very slow in the upper part and moderate in the lower part.



Important soil properties of this map unit:

Parent material:
Alluvium

Slope:
0 to 2 percent

Particle size:
Surface, 42 to 62% silt
28 to 54% clay
Subsoil, 12 to 86% silt
2 to 30% clay

Surface thickness:
Minimum, 11 inches
Maximum, 17 inches
Average, 12 inches

Thickness of clay:
10 to 20 inches

Available water:
Upper 40 inches;
4.5 to 7.0 inches

Drainage:
Moderately well drained, somewhat poorly drained

Depth to bedrock:
>60"

Base status: cmol (+) kg-1
Surface, 24.0 to 43.0
Subsoil, 12.0 to 50.0

CEC: cmol (+) kg-1
Surface, 22.0 to 40.0
Subsoil, 3.0 to 25.0

Clay mineralogy:
Smectitic

Sand mineralogy:
Mixed

Aluminum saturation:
Surface, NA
Subsoil, NA

Organic matter:
Surface, 1.5 to 2.2%
Subsoil, .16 to 1.3%

Base Saturation:
Surface, 69 to 100%
Subsoil, 83 to 100%

pH:
Surface, 5.8 to 8.0
Subsoil, 7.2 to 8.1

This map unit occurs on slightly concave areas on the highest landform positions or on escarpments of these higher positions. The units range from 0.2 to 20.9 acres in size. Typically the surface layer is very dark gray or very dark grayish brown, silty clay or silty clay loam from 11 to 17 inches thick. The subsoil is greater than 60 inches thick. It is dark grayish brown, brown or grayish brown silt loam, very fine sandy loam or fine sand.

The Parkville series was used to represent this map unit. None of the data collected fit the Parkville series exactly but all were similar to this series. There was no series that represented the data collected.

[3] – The Leta and Levasy map unit consist of very deep, somewhat poorly drained and poorly drained soils that formed in clayey alluvium over loamy alluvium. These soils are on flood plain steps. Permeability is slow to very slow in the upper part and moderate or in the lower part.

Important soil properties of this map unit:

Parent material:
Alluvium
Slope:
0 to 2 percent

Particle size:
Surface, 40 to 62% silt
35 to 62% clay
Subsoil, 35 to 71% silt
1 to 26% clay

Surface thickness:
Minimum, 5 inches
Maximum, 15 inches
Average, 11 inches

Thickness of clay:
20 to 40 inches

Available water:
Upper 40 inches:
5.4 to 6.8 inches

Drainage:
Somewhat poorly drained-Leta
Poorly drained-Levasy

Depth to bedrock:
>60"

Base status: cmol (+) kg-1
Surface, 35.0 to 42.0
Subsoil, 5.0 to 42.0

CEC: cmol (+) kg-1
Surface, 27.0 to 46.0
Subsoil, 2.0 to 40.0

Clay mineralogy:
Smectitic over mixed

Sand mineralogy:
Mixed

Aluminum saturation:
Surface, NA
Subsoil, NA

Organic matter:
Surface, 2.00 to 3.20%
Subsoil, .16 to 1.50%

Base Saturation:
Surface, 85 to 100%
Subsoil, 82 to 100%

pH:
Surface, 6.8 to 7.5
Subsoil, 6.6 to 8.1

This map unit occurs below the Haynie unit on landform positions of intermediate elevations. The units range from 0.6 to 92.5 acres in size.

Typically the surface layer is very dark gray, silty clay from 5 to 15 inches thick. The subsoil is greater than 60 inches thick. It is dark grayish brown or very dark grayish brown silty clay in the upper part and light brownish gray or brown silt loam, very

fine sandy loam or fine sand in the lower part.
The Leta and Levasy series were chosen to represent this map unit. The data collected support the use of these two series.

[4] – The Tieville-Lakeport map unit consists of very deep, somewhat poorly drained and poorly drained soils on flood plain steps. These soils formed in calcareous, clayey over loamy alluvium. The clayey alluvium ranges from 40 to 60 inches deep. Permeability is very slow in the upper part and moderately slow in the lower part.

Important soil properties of this map unit:

Parent material:
Alluvium

Slope:
0 to 2 percent

Particle size:
Surface, 35 to 58% silt
35 to 75% clay
Subsoil, 15 to 68% silt
16 to 27% clay

Surface thickness:
Minimum, 8 inches
Maximum, 16 inches
Average, 12 inches

Thickness of clay:
40 to 60 inches

Available water:
Upper 40 inches:
4.8 to 6.0 inches

Drainage:
Somewhat poorly drained-Lakeport
Poorly drained-Tieville

Depth to bedrock:
>60"

Base status: cmol (+) kg-1
Surface, 35.0 to 43.0
Subsoil, 22.0 to 42.0

CEC: cmol (+) kg-1
Surface, 38.0 to 46.0
Subsoil, 25.0 to 44.0
Subsoil, 8.0 to 22.0

Clay mineralogy:
Smectitic

Sand mineralogy:
Mixed

Aluminum saturation:
Surface, NA
Subsoil, NA

Organic matter:
Surface, 2.0 to 2.75%
Subsoil, .76 to 2.16%
Subsoil, .56 to .833%

Base Saturation:
Surface, 79 to 86%
Subsoil, 80 to 100%
Subsoil, 100%

pH:
Surface, 5.7 to 7.0
Subsoil, 6.8 to 8.0
Subsoil, 7.5 to 8.3

This map unit occurs on similar to slightly lower positions than the Leta-Levasy unit. It lies just above the sloughs. The units range from 1.2 to 35 acres in size.

Typically the surface layer is very dark brown or black, silty clay or clay from 8 to 16 inches

thick. The subsoil is greater than 60 inches thick. It is dark grayish brown or grayish brown silty clay or silty clay loam in the upper part and silt loam to fine sandy loam in the lower part.

The Tieville and Lakeport series were selected to represent this map unit. The data collected supported the use of these two series. The only difference found was that there were no free carbonate masses described in the Tieville soils.

[5] – The Wabash map unit consists of very deep, poorly and very poorly drained soils formed in alluvium. These soils are on flood plains.

Important soil properties of this map unit:

Parent material:
Alluvium

Slope:
0 to 2 percent

Particle size:
Surface, 47 to 64% silt
27 to 45% clay
Subsoil, 31 to 66% silt
28 to 68% clay

Surface thickness:
Minimum, 5 inches
Maximum, 12 inches
Average, 8 inches

Thickness of clay:
>60 inches

Available water:
Upper 40 inches:
5.2 to 6.2 inches

Drainage:
Poorly drained

Depth to bedrock:
>60"

Base status: cmol (+) kg-1
Surface, 36.0 to 55.0
Subsoil, 27.0 to 56.0

CEC: cmol (+) kg-1
Surface, 20.0 to 30.0
Subsoil, 22.0 to 48.0

Clay mineralogy:
Mixed

Aluminum saturation:
Surface, NA
Subsoil, NA

Organic matter:
Surface, 1.3 to 2.3%
Subsoil, .50 to 2.3%

Base Saturation:

Surface, 98 to 100%
Subsoil, 94 to 100%

pH:
Surface, 7.8 to 8.0
Subsoil, 7.5 to 8.0

This map unit occurs on the majority of the lower positions throughout the Park. The units range from 47 to 310 acres in size.

Typically the surface layer is very dark grayish brown, silty clay loam or silty clay from 5 to 12 inches thick. The subsoil is greater than 60 inches thick. It is very dark grayish brown or very dark brown silty clay, clay or silty clay loam. Textures below 60 inches range from silt loam to fine sand.

The Wabash series was selected for this map unit. The data collected supported the use of this series. The Wabash series is not considered to be calcareous which the lab data supported. There does not appear to be a series that fits the calcareous classification.

[6] – The Aholt map unit consists of very deep, very poorly drained soils on flood plains. Aholt soils formed in calcareous alluvium.

Important soil properties of this map unit:

Parent material:
Alluvium

Slope:
0 to 2 percent

Particle size:
Surface, 47 to 64% silt
27 to 45% clay
Subsoil, 31 to 66% silt
28 to 68% clay

Surface thickness:
Minimum, 5 inches
Maximum, 13 inches
Average, 8 inches

Thickness of clay:
>60 inches

Available water:
Upper 40 inches:
5.0 to 6.0 inches

Drainage:
Very poorly drained

Depth to bedrock
>60"

Base status: cmol (+) kg-1
Surface, 40.0 to 51.0
Subsoil, 25.0 to 52.0

CEC: cmol (+) kg-1
Surface, 21.0 to 30.0
Subsoil, 25.0 to 43.0

Clay mineralogy:
Smectitic

Aluminum saturation:
Surface, NA
Subsoil, NA

Organic matter:
Surface, 1.3 to 2.3%
Subsoil, .33 to 2.3%

Base Saturation:
Surface, 96 to 100%
Subsoil, 94 to 100%

pH:
Surface, 7.6 to 8.0
Subsoil, 7.6 to 8.0

This map unit occurs immediately adjacent to or within the sloughs. The units range from 1.0 to 82 acres in size.
Typically the surface layer is very dark grayish brown, silty clay loam or silty clay from 5 to 12 inches thick. The subsoil is greater than 60 inches thick. It is very dark grayish brown or very dark brown silty clay, clay or silty clay loam. Textures below 60 inches range from silt loam to fine sand.

The Aholt series was selected to represent this map unit. The lab data supported the use of this series.

[7] - The Blake map unit consists of very deep, somewhat poorly drained soils on flood plains. These soils formed in recently deposited calcareous, silty alluvium. Permeability is moderate in the upper part and moderate or moderately rapid in the lower part.

Important soil properties of this map unit:

Parent material:
Alluvium

Slope:
1 to 3 percent

Particle size:
Surface, 37 to 48% silt
12 to 18% clay
Subsoil, 8 to 75% silt
3 to 42% clay

Surface thickness:
Minimum, 14 inches
Maximum, 18 inches
Average, 16 inches

Thickness of clay:
Lenses above 40"

Available water:
Upper 40 inches:
6.0 to 7.4 inches

Drainage:
Moderately well
Somewhat poorly drained

Depth to bedrock:
>60"

Base status: cmol (+) kg-1
Surface, 20.0 to 27.0
Subsoil, 20.0 to 40.0

CEC: cmol (+) kg-1
Surface, 11.0 to 16.0
Subsoil, 6.0 to 35.0

Clay mineralogy:
Smectitic

Aluminum saturation:
Surface, NA
Subsoil, NA

Organic matter:
Surface, 1.0 to 1.66%
Subsoil, 0.5 to 1.66%

Base Saturation:
Surface, 100%
Subsoil, 100%

pH:
Surface, 7.7 to 8.1
Subsoil, 7.7 to 8.0

This map unit occurs on the natural levees along the edge of the park. The units range from 3.0 to 82 acres in size.

Typically the surface layer is very dark grayish brown and very dark gray, loam from 14 to 18 inches thick. The subsoil is greater than 60 inches thick. It is dark gray or very dark gray, stratified silt loam, loam or silty clay loam, silty clay or very fine sandy loam.

The Blake series was selected to represent this map unit. The lab data did not support the use of this series, but it was the best fit for the soils in this map unit. There was no series that represented the data collected. Use and management will be similar for these map units as for the Blake series.

[9] – The Haynie, escarpment map unit consists of very deep, moderately well drained soils on flood plain step escarpments. These soils formed in calcareous alluvium.

Important soil properties of this map unit:

Parent material:
Alluvium

Slope:
3 to 9 percent

Particle size:
Surface, 20 to 71% silt
15 to 27% clay
Subsoil, 1 to 45% silt
6 to 45% clay

Surface thickness:
Minimum, 8 inches
Maximum, 14 inches
Average, 12 inches

Thickness of clay:
No clay within 60"

Available water:
Upper 40 inches;
6.0 to 8.8 inches

Drainage:
Moderately well drained

Depth to bedrock:

>60"

Base status: cmol (+) kg-1
Surface, 15.0 to 37.0
Subsoil, 15.0 to 50.0

CEC: cmol (+) kg-1
Surface, 17.0 to 23.0
Subsoil, 4.0 to 33.0

Clay mineralogy:
Smectitic

Sand mineralogy:
Mixed

Aluminum saturation:
Surface, NA
Subsoil, NA

Organic matter:
Surface, 1.16 to 2.26%
Subsoil, .16 to 1.66%

Base Saturation:
Surface, 79 to 100%
Subsoil, 87 to 100%

pH:
Surface, 6.0 to 7.9
Subsoil, 6.8 to 8.2

This map unit occurs on the escarpments of higher landforms within the interior of the park. The units range from 4.5 to 6.5 acres in size.

Typically the surface layer is very dark grayish brown, silt loam, clay loam or very fine sandy loam from 8 to 14 inches thick. The subsoil is greater than 60 inches thick. It is dark grayish brown or very dark grayish brown silt loam to fine sand in the lower part.

The Haynie series was used to represent this map unit. Lab data from this unit was variable. This variability should not affect the use and management.

[10] – The Parkville, escarpment map unit consists of deep, calcareous, moderately well drained soils formed in clayey over loamy alluvium on escarpments of higher landforms. Permeability is slow to very slow in the upper part and moderate in the lower part.

Important soil properties of this map unit:

Parent material:
Alluvium

Slope:
3 to 9 percent

Particle size:
Surface, 42 to 62% silt
28 to 54% clay
Subsoil, 12 to 86% silt
2 to 30% clay

Surface thickness:
Minimum, 11 inches
Maximum, 17 inches
Average, 12 inches

Thickness of clay:
10 to 20 inches

Available water:
Upper 40 inches;
4.5 to 7.0 inches

Drainage:
Moderately well drained,
Somewhat poorly drained

Depth to bedrock:
>60"

Base status: cmol (+) kg-1
Surface, 24.0 to 43.0
Subsoil, 12.0 to 50.0

CEC: cmol (+) kg-1
Surface, 22.0 to 40.0
Subsoil, 3.0 to 25.0

Clay mineralogy:
Smectitic

Sand mineralogy:
Mixed

Aluminum saturation:
Surface, NA
Subsoil, NA

Organic matter:
Surface, 1.5 to 2.2%
Subsoil, .16 to 1.3%

Base Saturation:
Surface, 69 to 100%
Subsoil, 83 to 100%

pH:
Surface, 5.8 to 8.0
Subsoil, 7.2 to 8.1

This map unit occurs on slightly concave areas on the highest landform positions or on escarpments of these higher positions. The units range from 0.3 to 3.3 acres in size.

Typically the surface layer is very dark gray or very dark grayish brown, silty clay or silty clay loam from 11 to 17 inches thick. The subsoil is greater than 60 inches thick. It is dark grayish brown, brown or grayish brown silt loam, very fine sandy loam or fine sand.

The Parkville series was used to represent this map unit. None of the data collected fit the Parkville series exactly but all had properties similar to this series. There was no series that represented the data collected.

References

Buol S.W., Hole F.D., and McCracken R.J.,1980. Soil Genesis and Classification. Iowa State University Press. p. 133

Rowe, J.S., 1984. Forestland classification: limitations of the use of vegetation. In J.G. Bockheim (ed) Proceeding Symposium on Forest Land classification: Experience, Problems, Perspectives. Mar. 18-20, 1984. Madison, WI.

Simonson, Roy W. 1959. Outline Of A Generalized Theory Of Soil Genesis; Soil Science Society of America Proceedings, Vol. 23, Madison. p. 304

Soil Science Society of America, 1987. Glossary of Soil Science Terms; Madison. p. 23.

Soil Survey Division Staff, 1993, Soil Survey Manual: U.S. Department of Agriculture. Handbook No. 18. p. 73.

The World Publishing Company, 1978, Webster's New World Dictionary, Second College Edition: William Collins + World Publishing Company. p. 266.

United States Department of Agriculture. 1993. National Soil Survey Handbook, Glossary of Landform and Geologic Terms. Soil Conservation Service, USDA. p. 629-1 to 629-23.

USDA-Forest Service, 1993. National Hierarchical Framework of Ecological Units. Washington, D.C.: USDA. Forest Service, ECOMPA. 28p.

Wolf D. et al. United States Department of Agriculture. 1994. Soil Survey of Camden County, Missouri. Soil Conservation Service, USDA. p. 70.

Yaalon, D. H., 1983. Climate, time and soil development. In L.P. Wilding, N.E. Smeck, and G.F. Hall (eds) Pedogenesis and Soil Taxonomy I. Concepts and Interactions. Elseview, NY. p. 243.

Glossary

Alluvium -- Material, such as sand, silt, or clay, deposited on land by streams.

Aspect -- The direction toward which a slope faces with respect to the compass or to the rays of the sun.

Bases or Cations -- An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Base saturation -- The extent to which the adsorption complex of a soil is saturated with alkali or alkaline earth cations expressed as a percentage of the cation exchange capacity measured at pH of 7.0.

Bedrock -- A general term for the solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Cation exchange capacity -- the total amount of exchangeable cations that can be held by the soil. It is given in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Colluvium -- Unconsolidated, unsorted earth material being transported or deposited on sideslopes and/or at the base of slopes by mass movement and by local, unconcentrated runoff.

Drain -- A term restricted to relatively small, linear depressions that, at some time, move concentrated water and either lack a defined channel or have a small, defined channel.

Drainage class (natural) -- The frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained -- Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained -- Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained -- Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained -- Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained -- Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained -- Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Erosion (accelerated) -- Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire that exposes the surface.

Evapotranspiration -- The total water loss from the soil, including that by direct evaporation and that by transpiration from the plant surfaces.

Family Classes:

coarse-loamy -- <35% gravel and/or 15 to 70% sand, <18% clay.

coarse-silty -- <35% gravel and/or <15 sand, , <18% clay.

fine-silty -- <15% gravel and/or sand, 18 to 35% clay.

fine -- <35% gravel, 35 to 60% clay.

very fine -- <35% gravel, >60% clay.

clayey/loamy -- between 10 inches and a depth of 40"; an horizon containing >35% clay overlying an horizon with a texture of loamy very fine sand, very fine sand or finer with less than 35% clay. The two parts differ by a minimum of 25% clay.

Fluvial -- Of or pertaining to water deposits.

Horizon, soil -- A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

A horizon -- The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon -- The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon -- The mineral horizon below an A or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as: (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; (4) a combination of these.

C horizon -- The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Landform -- Any physical, recognizable form or feature on the earth's surface, having a characteristic shape, and produced by natural causes. Landforms provide an empirical description of similar portions of the earth's surface.

Landscape -- A collection of related, natural landforms; usually the land surface which the eye can comprehend in a single view.

Mineralogy -- The estimation or determination of the kinds or amounts of minerals present in a soil. Three general classes were used to describe clay mineralogy:

Kaolinitic -- Have more than one half (by weight) kaolinite, halloysite, dickite, and nacrite, and other 1:1 or non-expanding 2:1 layer minerals or gibbsite, and less than 10 percent smectite.

Smectitic -- Have more (by weight) montmorillonite, beidellite and nontronite, than any other single kind of clay mineral.

Mixed -- All other clay mineralogical combinations.

Organic matter -- Plant and animal residue in the soil in various stages of decomposition.

Reaction, soil -- A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as:

Extremely acid -- below 4.5
Very strongly acid -- 4.5 to 5.0
Strongly acid -- 5.1 to 5.5
Moderately acid -- 5.6 to 6.0
Slightly acid -- 6.1 to 6.5
Neutral -- 6.6 to 7.3
Slightly alkaline -- 7.4 to 7.8
Moderately alkaline -- 7.9 to 8.4
Strongly alkaline -- 8.5 to 9.0
Very strongly alkaline -- 9.1 and higher

Runoff -- The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or throughflow from ground water.

Series, soil -- A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Slope -- The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this report the following slope classes are recognized:

Nearly level -- 0 to 2 percent

Very gently sloping -- 1 to 3 percent

Moderately sloping -- 3 to 9 percent

Soil -- The unconsolidated mineral or organic matter on the surface of the earth that has been subjected to and influenced by genetic and environmental factors of: parent material, landform, climate, organisms and time and producing a product-soil-that differs from the material from which it is derived in many physical, chemical, biological and morphological properties, and characteristics.

Throughflow -- The downslope movement of water which takes place physically within the soil profile.

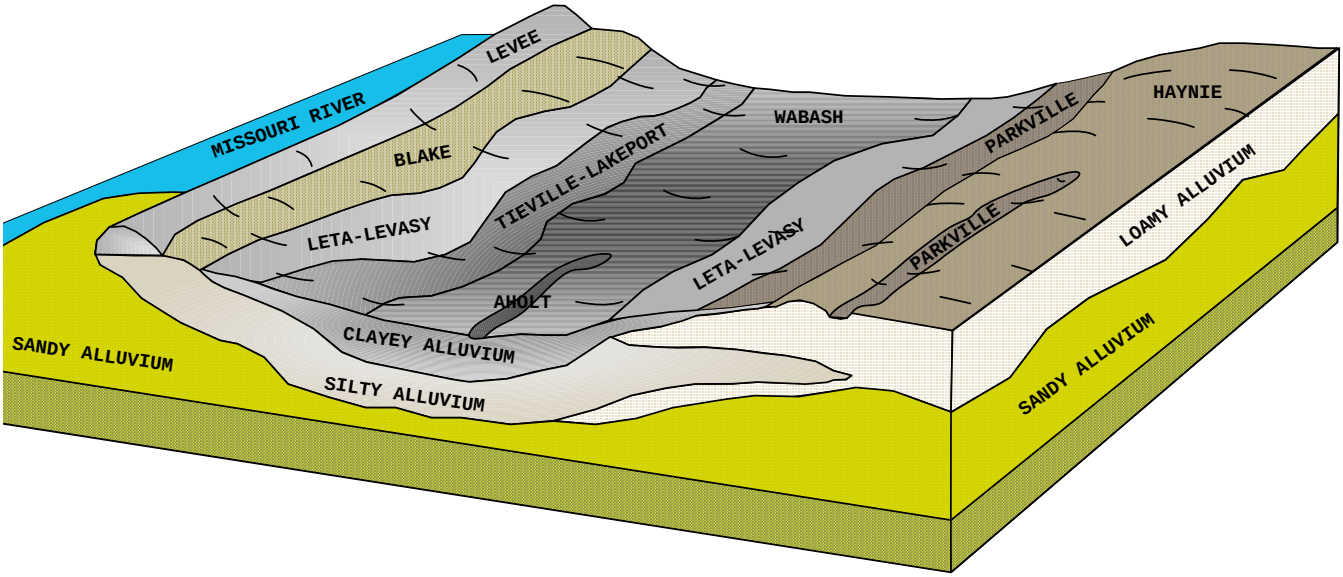
Water supplying capacity (AWC) -- The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as inches.

Very low -- 0 to 3 inches
Low -- 3 to 6 inches
Moderate -- 6 to 9 inches
High -- 9 to 12 inches
Very high -- >12 inches

APPENDICES

APPENDIX A

BLOCK DIAGRAM
OF
EDWARD (TED) AND PAT JONES
STATE PARK



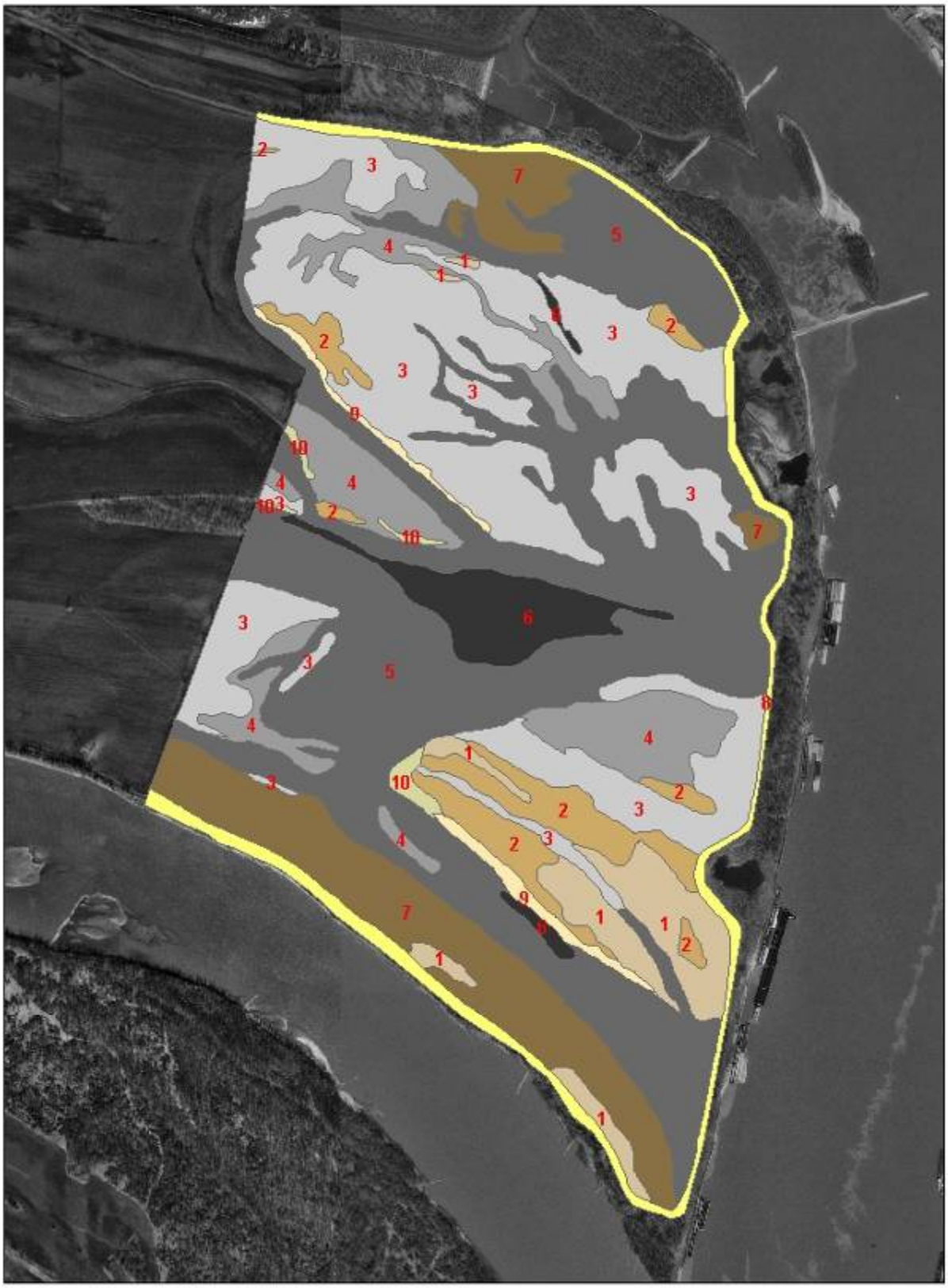
APPENDIX B

Index to Map Units

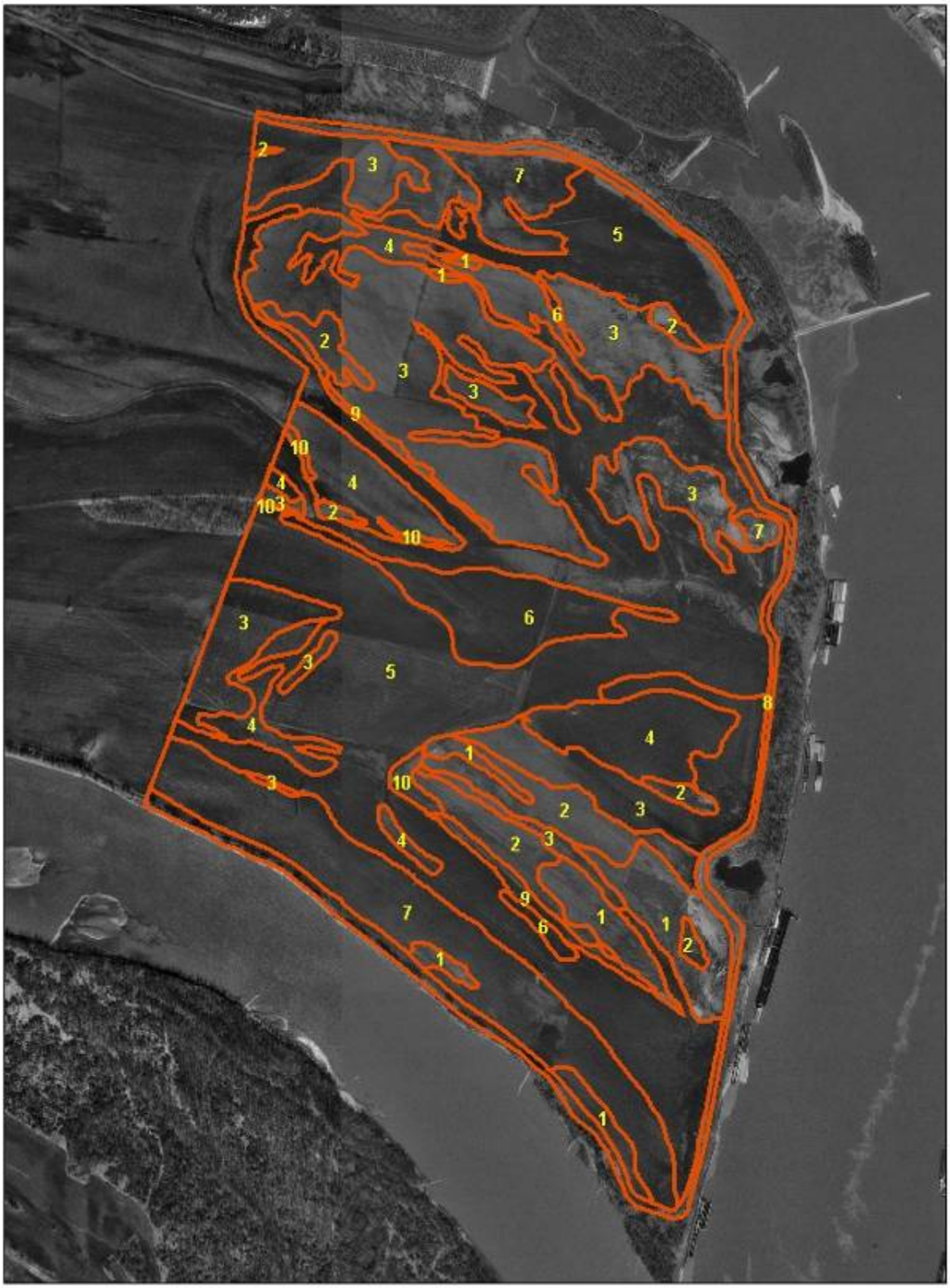
Map unit symbol	Map Unit Name
1	Haynie silt loam, 0 to 2 percent slopes
2	Parkville silty clay, 0 to 2 percent slopes
3	Leta-Levasy silty clay, 0 to 2 percent slopes
4	Tieville-Lakeport silty clay, 0 to 2 percent slopes
5	Wabash silty clay loam 0 to 2 percent slopes
6	Aholt silty clay, 0 to 2 percent slopes
7	Blake loam, 1 to 3 percent slopes
8	Levee
9	Haynie silt loam, 3 to 9 percent slopes, escarpment
10	Parkville silty clay loam, 3 to 9 percent slopes, escarpment

APPENDIX C

EDWARD (TED) AND PAT JONES CONFLUENCE STATE PARK SOIL MAP

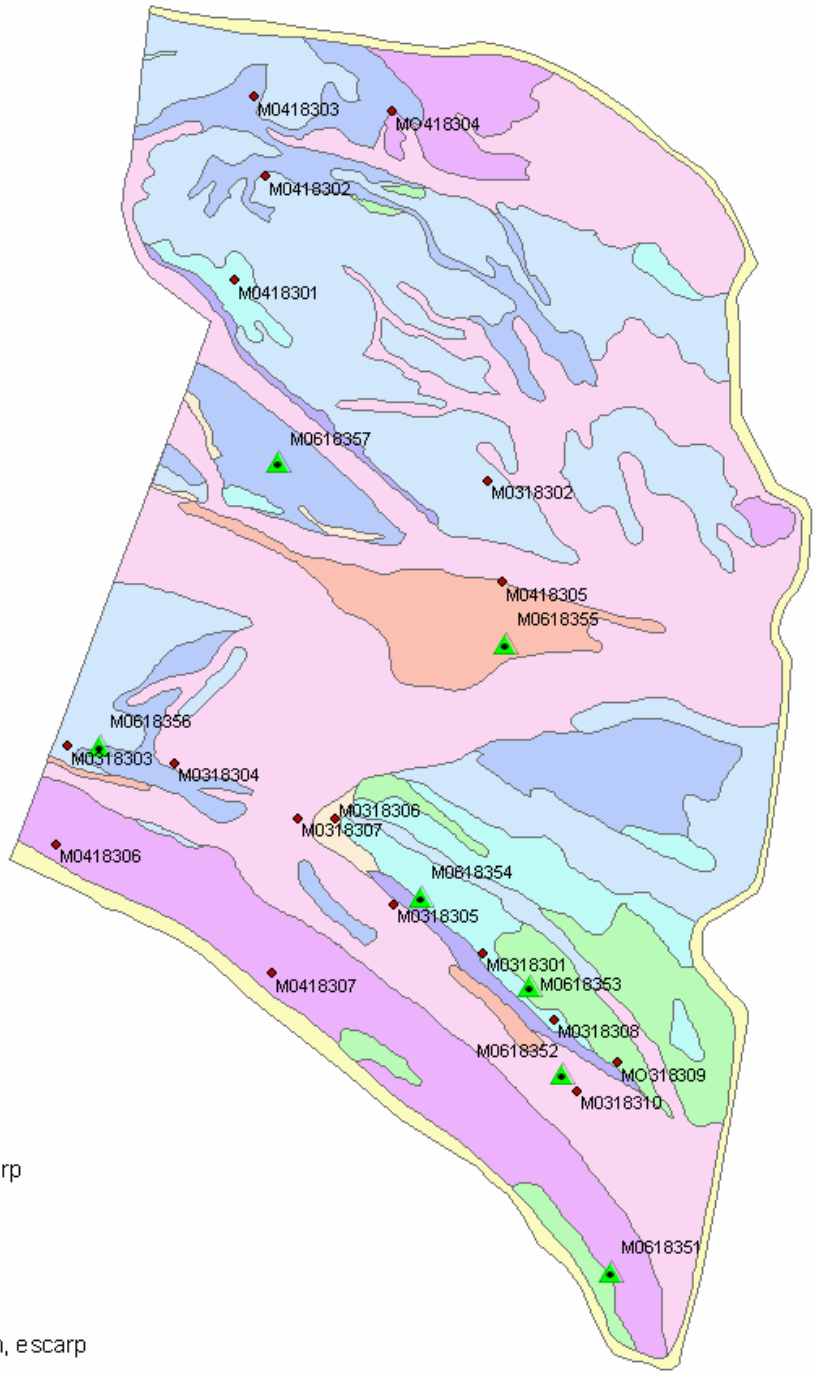


EDWARD (TED) AND PAT JONES
CONFLUENCE STATE PARK SOIL MAP



APPENDIX D

CONFLUENCE PEDON LOCATIONS



Map Legend

- Piezometers locations
- sample_locations

soillines

SOILNAME

- Aholt silty clay
- Blake loam
- Haynie silt loam
- Haynie silty loam, escarp
- Leta-Levasy silty clay
- Levee
- Parkville silty clay
- Parkville silty clay loam, escarp
- Tieville-Lakeport silty clay
- Wabash silty clay loam

APPENDIX E

Site ID: Name this Site Here		**Lab ID:** MCL M0318302		
Special Project: Confluence State Park				
Description Date: 5/20/2003		**Print Date:** 9/27/2006		
Describers Name(s): Dennis Meinert, Ralph Tucker, Grant Butler				
Site Notes:		**Pedon Notes:**		
Sampled Name: WALDRON	**Correlated Name:** LETA		**Certification:** Level 2	
Taxonomic Classification: Fine-silty, smectitic, superactive, calcareous, mesic Aquertic Hapludolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Series	
SSURGO MU: 71 - WALDRON SILTY CLAY, OCCASIONALLY FLOODED		**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association		
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part		**CRA:** M115B.3 - Missouri River Alluvial Plain		
County/SSA: MO183 - ST CHARLES, MO, USA		**7.5' Quad:** 38090-G1 - Wood River, Illinois		
Lat/Long: 38° 50' 17.6" N, 90° 7' 25.1" W		**UTM:** 749,658 E, 4,302,755N -- NAD83 , Zone 15		
Legal: 1,621 ft East and 581 ft North from the South West corner of S4, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley		**Landform:** flood-plain step		
Geomorphic Component: Tread		**Profile Position:** N/A		
Elevation: 412 ft	**Aspect:** 0°	**Slope:** 1%	**Shape:** up/down: Linear - across: Linear	
Flooding: frequent; brief		**Ponding:** none		
Drainage: Moderately well drained	**Runoff:** Negligible	Negligible **Perm:** Moderately slow	**Ksat:**	**Erosion:** None - deposition

Landcover: Crop cover ; Row crop
Parent Materials: Slightly weathered, clayey, Holocene Stage alluvium from mixed materials over slightly weathered, sandy and silty, Holocene Stage alluvium from mixed materials
Bedrock: N/A
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage
Particle Size Control Section: 10-40" (25-102cm); 30% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 19 inches (0-48 cm) Aquic conditions: 24 to 31 inches (61-79 cm)

SAMPLED AS LETA **MO318302**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 4 inches (0-10 cm); very dark gray (10YR 3/1, broken face) silty clay; weak fine subangular blocky structure; friable; common fine roots throughout, and common medium roots throughout; common very fine tubular, common fine tubular pores; abrupt smooth boundary.

A --- 4 to 19 inches (10-48 cm); very dark gray (10YR 3/1, broken face) silty clay; moderate fine subangular blocky structure; firm; common very fine roots throughout, and common fine roots throughout; common very fine tubular, common fine tubular pores; clear wavy boundary.

AB --- 19 to 24 inches (48-61 cm); dark gray (10YR 4/1, broken face) silty clay; moderate fine subangular blocky structure; firm; common very fine roots throughout, and common fine roots throughout; common very fine tubular, common fine tubular pores; few (10YR 5/3) distinct clay films on all faces of peds, few light gray (10YR 7/2) distinct sand coats on all faces of peds; abrupt smooth boundary.

Cg --- 24 to 31 inches (61-79 cm); 50% dark gray (10YR 4/1, broken face) , and 50% grayish brown (10YR 5/2, broken face) stratified silt loam; massive structure; friable; common very fine roots throughout; common very fine tubular, common fine tubular pores; few strong brown (7.5YR 5/8) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear wavy boundary.

C1 --- 31 to 40 inches (79-102 cm); brown (10YR 5/3, broken face) very fine sandy loam; massive structure; friable; common very fine roots throughout; common very fine tubular pores; abrupt wavy boundary.

C2 --- 40 to 60 inches (102-152 cm); brown (10YR 5/3, broken face) stratified sand; massive structure; loose; clear wavy boundary.

Cg’ --- 60 to 78 inches (152-198 cm); dark grayish brown (10YR 4/2, broken face) stratified silt loam; massive structure; friable; few strong brown (7.5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear wavy boundary.

C --- 78 to 86 inches (198-218 cm); pale brown (10YR 6/3, broken face) stratified fine sand; massive structure; friable; few strong brown (7.5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds.

Site ID: Name this Site Here		**Lab ID:** MCL M0318303		
Project: Confluence State Park				
Description Date: 7/29/2003		**Print Date:** 9/27/2006		
Describers Name(s): Dennis Meinert, David Skaer				
Site Notes:		**Pedon Notes:**		
Sampled Name: WALDRON	**Correlated Name:** LETA		**Certification:** Level 2	
Taxonomic Classification: Clayey over loamy, smectitic, superactive, calcareous, mesic Aquertic Hapludolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Series	
SSURGO MU: 71 - WALDRON SILTY CLAY, OCCASIONALLY FLOODED		**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association		
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part		**CRA:** M115B.3 - Missouri River Alluvial Plain		
County/SSA: MO183 - ST CHARLES, MO, USA **7.5'**		**Quad:** 38090-G2 - Columbia Bottom, Missouri		
Lat/Long: 38° 49' 57.7" N, 90° 8' 7.2" W		**UTM:** 748,661 E, 4,302,111N -- NAD83 , Zone 15		
Legal: 1,650 ft West and 1,532 ft South from the North East corner of S8, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley		**Landform:** flood-plain step		
Geomorphic Component: Tread		**Profile Position:** N/A		
Elevation: 416 ft	**Aspect:** 173°	**Slope:** 1%	**Shape:** up/down: Linear - across: Linear	
Flooding: frequent; brief		**Ponding:** none		
Drainage: Somewhat poorly drained	**Runoff:** Negligible	**Perm:** Very slow	**Ksat:**	**Erosion:** None - deposition - Gully erosion
Landcover: Crop cover ; Row crop **Observed Vegetative Species:** ALOPE- foxtail (Alopecurus) , XANTH2- cocklebur (Xanthium)				
Parent Materials: Slightly weathered, clayey, Holocene Stage alluvium from mixed materials over slightly weathered, sandy and silty, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				

Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage
Particle Size Control Section: 10-40" (25-102cm); 42% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 15 inches (0-38 cm) Aquic conditions: 15 to 114 inches (38-290 cm) Cambic horizon: 15 to 35 inches (38-89 cm)

LETA **MO318303**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 5 inches (0-13 cm); very dark gray (10YR 3/1, broken face) silty clay loam; weak very fine subangular blocky structure; friable; many very fine roots throughout; many fine interstitial, common fine tubular pores; abrupt smooth boundary.

A --- 5 to 15 inches (13-38 cm); black (10YR 2/1, broken face) silty clay; strong fine and medium angular blocky structure; firm; common very fine roots throughout; common fine tubular pores; common (10YR 2/1) faint organic stains on all faces of peds; clear smooth boundary.

Bg1 --- 15 to 26 inches (38-66 cm); dark grayish (10YR 4/2, broken face) silty clay; moderate medium subangular blocky parting to weak fine angular blocky structure; firm; common fine roots throughout; few fine tubular pores; many dark gray (2.5Y 4/1) prominent organic stains on all faces of peds; few brown (7.5YR 4/3) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few reddish brown (5YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few black (10YR 2/1) fine distinct masses of iron-manganese accumulation on faces of peds; Note: Two thin layers of silt loam strata (10YR 5/3M); clear smooth boundary.

Bg2 --- 26 to 35 inches (66-89 cm); dark grayish brown (10YR 4/2, broken face) silty clay; weak fine prismatic parting to weak fine angular blocky structure; firm; common very fine roots throughout, and common fine roots throughout; common fine tubular pores; many dark (2.5Y 4/1) prominent organic stains on all faces of peds, many gray (2.5Y 5/1) prominent organic stains on all faces of peds; few yellowish brown (10YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Lenses of silt loam (10yr 5/3M); clear smooth boundary.

Cg1 --- 35 to 45 inches (89-114 cm); 65% brown (10YR 5/3, broken face) , and 35% gray (10YR 5/1, broken face) stratified silt loam; massive structure; very friable; common very fine roots throughout; common fine tubular pores; few strong brown (7.5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few black (10YR 2/1) fine distinct masses of iron-manganese accumulation on faces of peds; Note: The massive structure is made up of thin bedding planes.; gradual smooth boundary.

Cg2 --- 45 to 55 inches (114-140 cm); 50% light olive brown (2.5Y 5/3, broken face) , and 50% grayish brown (2.5Y 5/2, broken face) stratified very fine sandy loam; massive structure; very friable; common fine roots throughout; common very fine tubular pores; Note: The massive structure is made up of thin bedding planes.; gradual smooth boundary.

Cg3 --- 55 to 67 inches (140-170 cm); 90% light olive brown (2.5Y 5/3, broken face) , and 10% gray (2.5Y 5/1, broken face) stratified silt loam; massive structure; very friable; common fine roots throughout; common fine tubular pores; few strong brown (7.5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation lining pores; Note: The massive structure is made up of thin bedding planes. Texture goes to silt loam at lower contact.; gradual smooth boundary.

Cg4 --- 67 to 72 inches (170-183 cm); dark (10YR 4/1, broken face) stratified silty clay loam; massive structure; firm; common fine roots throughout; common fine tubular pores; common reddish (5YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: The massive structure is made up of thin bedding planes. Horizon broken on changes in texture of strata.; abrupt smooth boundary.

Cg5 --- 72 to 114 inches (183-290 cm); 34% brown (10YR 5/3, broken face) , 33% dark grayish brown (10YR 4/2, broken face) , and 33% dark gray (10YR 4/1, broken face) stratified silt loam; massive structure; very friable; few very fine roots in mat at top of horizon; common fine tubular pores; few reddish brown (5YR 4/4) fine and medium prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Horizon split sampled: 72-86" (SIL), 86-98" (SIL), 98-114 (VFSL).

Site ID: Name this Site Here		**Lab ID:** MCL M0318304		
Special Project: Confluence State Park				
Description Date: 7/29/2003		**Print Date:** 9/27/2006		
Describers Name(s): Dennis Meinert David Skaer				
Site Notes:		**Pedon Notes:**		
Sampled Name: WALDRON	**Correlated Name:** WABASH		**Certification:** Level 2	
Taxonomic Classification: Fine, smectitic, superactive, calcareous, mesic Cumulic Vertic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Series	
SSURGO MU: 71 - WALDRON SILTY CLAY, OCCASIONALLY FLOODED		**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association		
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part		**CRA:** M115B.3 - Missouri River Alluvial Plain		
County/SSA: MO183 - ST CHARLES, MO, USA		**7.5' Quad:** 38090-G2 - Columbia Bottom, Missouri		
Lat/Long: 38° 49' 55.7" N, 90° 7' 57.2" W		**UTM:** 748,905 E, 4,302,056N -- NAD83 , Zone 15		
Legal: 849 ft West and 1,712 ft South from the North East corner of S8, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley		**Landform:** flood-plain step		
Geomorphic Component: Tread		**Profile Position:** N/A		
Elevation: 412 ft	**Aspect:** 0°	**Slope:** 1%	**Shape:** up/down: Linear - across: Linear	
Flooding: frequent; brief		**Ponding:** occasional; brief		
Drainage: Poorly drained	**Runoff:** Negligible	**Perm:** Slow	**Ksat:**	**Erosion:** None - deposition
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, clayey, Holocene Stage alluvium from mixed materials over slightly weathered, sandy and silty, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				

Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage
Particle Size Control Section: 10-40" (25-102cm); 47% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 29 inches (0-74 cm) Aquic conditions: 5 to 86 inches (13-218 cm) Cambic horizon: 5 to 45 inches (13-114 cm)

WABASH **MO318304**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 7 inches (0-18 cm); very dark gray (10YR 3/1, broken face) silty clay loam; weak fine granular structure; very friable; common fine roots throughout; many fine interstitial, many fine tubular pores; abrupt smooth boundary.

Bw1 --- 7 to 12 inches (18-30 cm); black (10YR 2/1, broken face) silty clay loam; weak fine and medium subangular blocky structure; firm; common fine roots throughout; few fine tubular pores; common black (10YR 2/1) faint organic stains on all faces of peds; abrupt smooth boundary.

Bg2 --- 12 to 20 inches (30-51 cm); very dark gray (10YR 3/1, broken face) silty clay loam; weak fine angular blocky structure; firm; common fine roots throughout; many fine tubular, many medium tubular pores; few brown (10YR 5/3) faint silt coats on all faces of peds; few dark yellowish brown (10YR 3/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few reddish brown (5YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few black (10YR 2/1) fine faint masses of iron-manganese accumulation on faces of peds; Note: Two thin layers of strata of SIL (10YR 5/3); clear smooth boundary.

Bg3 --- 20 to 26 inches (51-66 cm); 60% very dark grayish brown (10YR 3/2, broken face) , and 40% brown (10YR 5/3, broken face) silty clay loam; weak fine subangular blocky structure; firm; common fine roots throughout; many fine tubular, many medium tubular, many coarse tubular pores; few gray (2.5Y 5/1) faint clay films on all faces of peds; few strong brown (7.5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Mixed color: 10YR 3/2; clear smooth boundary.

Bg4 --- 26 to 33 inches (66-84 cm); very dark gray (10YR 3/1, broken face) silty clay; moderate fine angular blocky structure; firm; common fine roots throughout; common fine tubular pores; few brown (7.5YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few black (10YR 2/1) fine faint masses of iron-manganese accumulation on faces of peds; clear smooth boundary.

Bg5 --- 33 to 37 inches (84-94 cm); dark gray (2.5Y 4/1, broken face) clay; moderate medium angular blocky structure; firm; common fine roots throughout; common fine tubular pores; few yellowish red (5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

Bg6 --- 37 to 44 inches (94-112 cm); very dark gray (10YR 3/1, broken face) silty clay loam; moderate fine subangular blocky structure; firm; common fine roots throughout; common fine tubular, common medium tubular pores; few dark reddish brown (2.5YR 3/3) fine and medium prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few dark red (2.5YR 3/6) fine and medium prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

Bg7 --- 44 to 60 inches (112-152 cm); dark gray (2.5Y 4/1, broken face) clay; weak coarse angular blocky structure; firm; common fine roots throughout; few fine tubular pores; few yellowish red (5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few brown (7.5YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few black (10YR 2/1) fine faint masses of iron-manganese accumulation on faces of peds; abrupt smooth boundary.

C --- 60 to 70 inches (152-178 cm); 34% brown (10YR 4/3, broken face) , 33% strong brown (7.5YR 4/6, broken face) , and 33% grayish brown (10YR 5/2, broken face) stratified very fine sandy loam; massive structure; friable; few fine tubular pores; few black (10YR 2/1) fine faint masses of iron-manganese accumulation on faces of peds; clear smooth boundary.

Cg --- 70 to 90 inches (178-229 cm); dark gray (2.5Y 4/1, broken face) silt loam; moderate fine angular blocky structure; firm; common fine tubular, common medium tubular pores; few dark reddish brown (2.5YR 3/3) medium prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few black (10YR 2/1) fine faint masses of iron-manganese accumulation on faces of peds; Note: 208cm approximate water table. Split sampled, 178-203cm (SIL) 203-229cm (FS).

Site ID: Name this Site Here			**Lab ID:** MCL M0318305	
Special Project: Confluence State Park				
Description Date: 7/29/2003			**Print Date:** 9/27/2006	
Describers Name(s): Dennis Meinert				
Site Notes:			**Pedon Notes:**	
Site Notes: Pedon Notes: Sampled Name: WALDRON	**Correlated Name:** WABASH		**Certification:** Level 2	
Taxonomic Classification: Fine, smectitic, superactive, calcareous, mesic Cumulic Vertic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Series	
SSURGO MU: 71 - WALDRON SILTY CLAY, OCCASIONALLY FLOODED			**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association	
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part			**CRA:** M115B.3 - Missouri River Alluvial Plain	
County/SSA: MO183 - ST CHARLES, MO, USA			**7.5' Quad:** 38090-G2 - Columbia Bottom, Missouri	
Lat/Long: 38° 49' 44.1" N, 90° 7' 35.9" W			**UTM:** 749,431 E, 4,301,716N -- NAD83 , Zone 15	
Legal: 876 ft East and 2,828 ft South from the North West corner of S9, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley			**Landform:** flood-plain step	
Geomorphic Component: Tread			**Profile Position:** N/A	
Elevation: 410 ft	**Aspect:** 0°		**Slope:** 0.5%	**Shape:** up/down: Linear - across: Linear
Flooding: frequent; brief			**Ponding:** occasional; brief	
Drainage: Poorly drained	**Runoff:** Negligible	**Perm:** Slow	**Ksat:**	**Erosion:** None - deposition
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, clayey, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				

Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage
Particle Size Control Section: 10-40" (25-102cm); 42% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 33 inches (0-84 cm) Cambic horizon: 7 to 60 inches (18-152 cm) Aquic conditions: 12 to 80 inches (30-203 cm)

WABASH **MO318305**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 7 inches (0-18 cm); 65% very dark grayish brown (10YR 3/2, broken face) , and 35% brown (10YR 5/3, broken face) silty clay loam; moderate fine granular structure; friable; many fine roots throughout; common fine interstitial pores; few brown (7.5YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: 10YR 3/2 mixed.; abrupt smooth boundary.

Bg --- 7 to 14 inches (18-36 cm); very dark gray (10YR 3/1, broken face) silty clay loam; moderate fine and medium angular blocky structure; firm; common fine roots throughout; common fine tubular pores; few brown (7.5YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: 10YR 5/3 lenses present.; clear smooth boundary.

Cg1 --- 14 to 25 inches (36-64 cm); 50% gray (10YR 5/1, broken face) , and 50% brown (10YR 5/3, broken face) stratified very fine sandy loam; massive structure; very friable; common fine roots throughout; many fine tubular pores; gradual smooth boundary.

Cg2 --- 25 to 38 inches (64-97 cm); 34% pale brown (10YR 6/3, broken face) , 33% dark gray (10YR 4/1, broken face) , and 33% grayish brown (10YR 5/2, broken face) stratified very fine sandy loam; massive structure; friable; common fine roots throughout; common fine tubular pores; few yellowish brown (10YR 5/6) fine distinct masses of oxidized iron (fe+3) accumulation on faces of peds, few black (10YR 2/1) fine prominent masses of iron-manganese accumulation on faces of peds; gradual smooth boundary.

Cg3 --- 38 to 48 inches (97-122 cm); 50% brown (10YR 5/3, broken face) , and 50% grayish brown (10YR 5/2, broken face) stratified very fine sandy loam; massive structure; very friable; common fine roots throughout; common fine tubular pores; clear smooth boundary.

Cg4 --- 48 to 55 inches (122-140 cm); 34% dark gray (10YR 4/1, broken face) , 33% grayish brown (10YR 5/2, broken face) , and 33% pale brown (10YR 6/3, broken face) stratified very fine sandy loam; lenticular platy structure; very friable; common fine roots throughout; common fine tubular pores; few reddish brown (5YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few dark yellowish brown (10YR 4/4) fine distinct masses of

oxidized iron (fe+3) accumulation on faces of peds; Note: Redox. features located at base of horizon.; clear smooth boundary.

Cg5 --- 55 to 64 inches (140-163 cm); grayish brown (10YR 5/2, broken face) stratified silt loam; massive structure; friable; common fine roots throughout; common fine tubular pores; few reddish brown (5YR 4/4) medium prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few black (10YR 2/1) fine prominent masses of iron-manganese accumulation on faces of peds; Note: 4cm of SICL material at base (weak fine SBK structure).; abrupt smooth boundary.

Cg6 --- 64 to 80 inches (163-203 cm); 34% olive yellow (2.5Y 6/6, broken face) , 33% light olive brown (2.5Y 5/3, broken face) , and 33% grayish brown (10YR 5/2, broken face) stratified very fine sand; massive structure; friable; common fine roots throughout; common fine tubular pores; few reddish brown (5YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

Cg7 --- 80 to 106 inches (203-269 cm); dark gray (10YR 4/1, broken face) stratified silty clay loam; massive structure; firm; common fine tubular pores; few black (10YR 2/1) fine prominent masses of iron-manganese accumulation on faces of peds, few yellowish brown (10YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few dusky red (10R 3/3) coarse prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: 10YR 5/3 lenses present.

Site ID: Name this Site Here			**Lab ID:** MCL M0318306	
Special Project: Confluence State Park				
Description Date: 7/29/2003			**Print Date:** 9/27/2006	
Describers Name(s): Dennis Meinert				
Site Notes:			**Pedon Notes:**	
Sampled Name: WALDRON	**Correlated Name:** PARKVILLE		**Certification:** Level 2	
Taxonomic Classification: Coarse-loamy, mixed, superactive, calcareous, mesic Fluvaquentic Vertic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxajunct	
SSURGO MU: 71 - WALDRON SILTY CLAY, OCCASIONALLY FLOODED			**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association	
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part			**CRA:** M115B.3 - Missouri River Alluvial Plain	
County/SSA: MO183 - ST CHARLES, MO, USA			**7.5' Quad:** 38090-G2 - Columbia Bottom, Missouri	
Lat/Long: 38° 49' 51.1" N, 90° 7' 41.5" W			**UTM:** 749,287 E, 4,301,926N -- NAD83 , Zone 15	
Legal: 404 ft East and 2,139 ft South from the North West corner of S9, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley			**Landform:** flood-plain step	
Geomorphic Component: Riser			**Profile Position:** N/A	
Elevation: 410 ft	**Aspect:** 280°		**Slope:** 8%	**Shape:** up/down: Convex - across: Convex
Flooding: frequent; brief			**Ponding:** none	
Drainage: Somewhat poorly drained	**Runoff:** Negligible	**Perm:** Moderately slow	**Ksat:**	**Erosion:** None - deposition
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, silty, Holocene Stage alluvium from mixed materials over slightly weathered, sandy, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage				

Particle Size Control Section: 10-40" (25-102cm); 9% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 14 inches (0-36 cm) Aquic conditions: 7 to 106 inches (18-269 cm) Cambic horizon: 7 to 14 inches (18-36 cm)

PARKVILLE **MO318306**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 7 inches (0-18 cm); 65% very dark grayish brown (10YR 3/2, broken face) , and 35% brown (10YR 5/3, broken face) silty clay loam; moderate fine granular structure; friable; many fine roots throughout; common fine interstitial pores; few brown (7.5YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: 10YR 3/2 mixed.; abrupt smooth boundary.

Bg --- 7 to 14 inches (18-36 cm); very dark gray (10YR 3/1, broken face) silty clay loam; moderate fine and medium angular blocky structure; firm; common fine roots throughout; common fine tubular pores; few brown (7.5YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: 10YR 5/3 lenses present.; clear smooth boundary.

Cg1 --- 14 to 25 inches (36-64 cm); 50% gray (10YR 5/1, broken face) , and 50% brown (10YR 5/3, broken face) stratified very fine sandy loam; massive structure; very friable; common fine roots throughout; many fine tubular pores; gradual smooth boundary.

Cg2 --- 25 to 38 inches (64-97 cm); 34% pale brown (10YR 6/3, broken face) , 33% dark gray (10YR 4/1, broken face) , and 33% grayish brown (10YR 5/2, broken face) stratified very fine sandy loam; massive structure; friable; common fine roots throughout; common fine tubular pores; few yellowish brown (10YR 5/6) fine distinct masses of oxidized iron (fe+3) accumulation on faces of peds, few black (10YR 2/1) fine prominent masses of iron-manganese accumulation on faces of peds; gradual smooth boundary.

Cg3 --- 38 to 48 inches (97-122 cm); 50% brown (10YR 5/3, broken face) , and 50% grayish brown (10YR 5/2, broken face) stratified very fine sandy loam; massive structure; very friable; common fine roots throughout; common fine tubular pores; clear smooth boundary.

Cg4 --- 48 to 55 inches (122-140 cm); 34% dark gray (10YR 4/1, broken face) , 33% grayish brown (10YR 5/2, broken face) , and 33% pale brown (10YR 6/3, broken face) stratified very fine sandy loam; lenticular platy structure; very friable; common fine roots throughout; common fine tubular pores; few reddish brown (5YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few dark yellowish brown (10YR 4/4) fine distinct masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Redox. features located at base of horizon.; clear smooth boundary.

Cg5 --- 55 to 64 inches (140-163 cm); grayish brown (10YR 5/2, broken face) stratified silt loam; massive structure; friable; common fine roots throughout; common fine tubular pores; few reddish brown (5YR 4/4) medium prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few black (10YR 2/1) fine prominent masses of iron-manganese accumulation on faces of peds; Note(s): 4cm of SICL material at base (weak fine SBK structure).; abrupt smooth boundary.

Cg6 --- 64 to 80 inches (163-203 cm); 34% olive yellow (2.5Y 6/6, broken face) , 33% light olive brown (2.5Y 5/3, broken face) , and 33% grayish brown (10YR 5/2, broken face) stratified very fine sand; massive structure; friable; common fine roots throughout; common fine tubular pores; few reddish brown (5YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

Cg7 --- 80 to 106 inches (203-269 cm); dark gray (10YR 4/1, broken face) stratified silty clay loam; massive structure; firm; common fine tubular pores; few black (10YR 2/1) fine prominent masses of iron-manganese accumulation on faces of peds, few yellowish brown (10YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few dusky red (10R 3/3) coarse prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: 10YR 5/3 lenses present.

Site ID: Name this Site Here			**Lab ID:** MCL M0318307	
Special Project: Confluence State Park				
Description Date: 7/29/2003			**Print Date:** 9/28/2006	
Describers Name(s): Dennis Meinert				
Site Notes:			**Pedon Notes:**	
Sampled Name: WALDRON	**Correlated Name:** WABASH		**Certification:** Level 2	
Taxonomic Classification: Fine, smectitic, superactive, calcareous, mesic Fluvaquentic Vertic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Family	
SSURGO MU: 71 - WALDRON SILTY CLAY, OCCASIONALLY FLOODED			**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association	
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part			**CRA:** M115B.3 - Missouri River Alluvial Plain	
County/SSA: MO183 - ST CHARLES, MO, USA			**7.5' Quad:** 38090-G2 - Columbia Bottom, Missouri	
Lat/Long: 38° 49' 51.5" N, 90° 7' 44.7" W			**UTM:** 749,210 E, 4,301,935N -- NAD83 , Zone 15	
Legal: 151 ft East and 2,109 ft South from the North West corner of S9, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley			**Landform:** flood-plain step	
Geomorphic Component: Tread			**Profile Position:** N/A	
Elevation: 410 ft	**Aspect:** 0°		**Slope:** 0.5%	**Shape:** up/down: Linear - across: Linear
Flooding: frequent; brief			**Ponding:** occasional; brief	
Drainage: Somewhat poorly drained	**Runoff:** Negligible	**Perm:** Slow	**Ksat:**	**Erosion:** None - deposition
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, clayey, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage				

Particle Size Control Section: 10-40" (25-102cm); 47% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 14 inches (0-36 cm) Cambic horizon: 6 to 56 inches (15-142 cm) Aquic conditions: 14 to 85 inches (36-216 cm)

WABASH **MO318307**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 6 inches (0-15 cm); very dark gray (10YR 3/1, broken face) silty clay loam; moderate fine granular structure; friable; many fine roots throughout; many fine tubular pores; abrupt smooth boundary.

Bg1 --- 6 to 14 inches (15-36 cm); black (10YR 2/1, broken face) silty clay; moderate fine and medium subangular blocky structure; firm; common fine roots throughout; many fine tubular pores; very few brown (10YR 4/3) faint silt coats on all faces of peds; clear smooth boundary.

Bg2 --- 14 to 24 inches (36-61 cm); black (10YR 2/1, broken face) silty clay loam; weak medium angular blocky structure; firm; common fine roots throughout; common fine tubular pores; few dark yellowish brown (10YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

Bg3 --- 24 to 37 inches (61-94 cm); very dark gray (10YR 3/1, broken face) silty clay; moderate fine and medium subangular blocky structure; firm; common fine roots throughout; many fine tubular pores; few dark reddish brown (5YR 3/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

Bg4 --- 37 to 51 inches (94-130 cm); 70% very dark gray (10YR 3/1, broken face) , and 30% black (10YR 2/1, broken face) silty clay; moderate coarse angular blocky structure; firm; common fine roots throughout; many fine tubular, many medium tubular pores; few dark brown (7.5YR 3/2) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few dark red (2.5YR 3/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

Bg5 --- 51 to 56 inches (130-142 cm); 90% very dark grayish brown (2.5Y 3/2, broken face) , and 10% very dark gray (10YR 3/1, broken face) silty clay; strong medium angular blocky structure; firm; common fine roots throughout; common fine tubular pores; few dark red (2.5YR 3/6) fine prominent masses of oxidized iron (fe+3) accumulation on surfaces along root channels; abrupt wavy boundary.

Cg --- 56 to 68 inches (142-173 cm); 34% brown (10YR 4/3, broken face) , 33% olive brown (2.5Y 4/3, broken face) , and 33% very dark gray (10YR 3/1, broken face) stratified silt loam; massive structure; firm; common fine roots throughout; common fine tubular pores; few dark brown (7.5YR 3/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few brown (10YR 4/3) fine prominent iron-manganese nodules on faces of peds, few black (10YR 2/1) fine distinct masses of iron-manganese accumulation on faces of peds; Note: Stata consisted of fine bedding planes.; gradual wavy boundary.

C --- 68 to 85 inches (173-216 cm); olive brown (2.5Y 4/4, broken face) stratified silt loam; massive structure; friable; common fine roots throughout; common fine tubular pores; few dark grayish brown (10YR 4/2) fine distinct iron depletions on faces of peds, few dark brown (7.5YR 3/4) fine prominent manganese coatings on faces of peds, few black (10YR 2/1) fine distinct iron-manganese nodules on faces of peds; Note: One thin strata of fine sand present.

Site ID: Name this Site Here		**Lab ID:** MCL M0318308		
Special Project: Confluence State Park				
Description Date: 8/21/ 2003		**Print Date:** 9/28/2006		
Describers Name(s): Dennis Meinert				
Site Notes:		**Pedon Notes:** One inch more of the silty clay material and family would be clayey over fine-silty.		
Sampled Name: WALDRON	**Correlated Name:** PARKVILLE		**Certification:** Level 2	
Taxonomic Classification: Fine-silty, smectitic, superactive, calcareous, mesic Fluvaquentic Vertic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxadjunct	
SSURGO MU: 71 - WALDRON SILTY CLAY, OCCASIONALLY FLOODED		**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association		
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part		**CRA:** M115B.3 - Missouri River Alluvial Plain		
County/SSA: MO183 - ST CHARLES, MO, USA		**7.5' Quad:** 38090-G1 - Wood River, Illinois		
Lat/Long: 38° 49' 34.7" N, 90° 7' 19.4" W		**UTM:** 749,838 E, 4,301,438N -- NAD83 , Zone 15		
Legal: 846 ft West and 3,111 ft North from the South East corner of S9, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley		**Landform:** flood-plain step		
Geomorphic Component: Tread		**Profile Position:** N/A		
Elevation: 410 ft	**Aspect:** 225°	**Slope:** 0.5%	**Shape:** up/down: Linear - across: Linear	
Flooding: frequent; brief		**Ponding:** rare; very brief		
Drainage: Somewhat poorly drained	**Runoff:** Negligible	**Perm:** Slow	**Ksat:**	**Erosion:** None - deposition
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, clayey, Holocene Stage alluvium from mixed materials over slightly weathered, sandy and silty, Holocene Stage alluvium from mixed materials				

Bedrock: N/A
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage
Particle Size Control Section: 10-40" (25-102cm); 25% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 13 inches (0-33 cm) Cambic horizon: 3 to 13 inches (8-33 cm)

PARKVILLE **M0318308**

Horizon Description **Observation method:** Push Tube

A --- 0 to 3 inches (0-8 cm); very dark gray (10YR 3/1, broken face) silty clay; moderate medium granular structure; firm; many fine roots throughout; many fine interstitial pores; Note(s): non-effervescent.; abrupt smooth boundary.

Bg1 --- 3 to 13 inches (8-33 cm); very dark gray (10YR 3/1, broken face) silty clay; moderate fine subangular blocky structure; firm; common fine roots throughout; common fine tubular pores; few strong brown (7.5YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few dark grayish brown (10YR 4/2) fine faint masses of oxidized iron (fe+3) accumulation on faces of peds; Note: non-effervescent. Redox features located in bottom 2 inches of horizon.; clear smooth boundary.

C --- 13 to 20 inches (33-51 cm); light yellowish brown (10YR 6/4, broken face) silt loam; massive structure; friable; common fine roots throughout; common fine tubular pores; few dark yellowish brown (10YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: non-effervescent. Medium bedding planes.; abrupt smooth boundary.

Cg1 --- 20 to 34 inches (51-86 cm); dark grayish brown (10YR 4/2, broken face) stratified silty clay loam; weak fine angular blocky structure; firm; common fine roots throughout; common fine tubular pores; few dark yellowish brown (10YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: slight effervescence.; abrupt smooth boundary.

Cg2 --- 34 to 48 inches (86-122 cm); 34% brown (10YR 4/3, broken face) , 33% grayish brown (10YR 5/2, broken face) , and 33% very dark grayish brown (10YR 3/2, broken face) stratified silt loam; massive structure; friable; few fine roots throughout; common fine tubular pores; few yellowish brown (10YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few dark yellowish brown (10YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Fine bedding planes.; clear smooth boundary.

Cg3 --- 48 to 56 inches (122-142 cm); grayish brown (10YR 5/2, broken face) silt loam; massive structure; friable; few fine roots throughout; common fine tubular pores; few yellowish brown

(10YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: slight effervescence.; abrupt smooth boundary.

C’ --- 56 to 66 inches (142-168 cm); light olive brown (2.5Y 5/3, broken face) very fine sandy loam; massive structure; friable; common fine tubular pores; few strong brown (7.5YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: slight effervescence.; clear smooth boundary.

Cg1’ --- 66 to 80 inches (168-203 cm); 60% dark grayish brown (2.5Y 4/2, broken face) , and 40% dark gray (2.5Y 4/1, broken face) silt loam; massive structure; friable; common fine tubular pores; few strong brown (7.5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: slight effervescence. Very fine bedding planes.; clear smooth boundary.

Cg2 --- 80 to 90 inches (203-229 cm); 60% light olive brown (2.5Y 5/3, broken face) , and 40% light reddish gray (2.5YR 6/4, broken face) fine sand; single grain structure; loose; common fine tubular pores; few strong brown (7.5YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: very slight effervescence..

Site ID: Name this Site Here			**Lab ID:** MCL M0318309	
Special Project: Confluence State Park				
Description Date: 8/21/2003			2003 **Print Date:** 9/28/2006	
Describers Name(s): Dennis Meinert				
Site Notes:			**Pedon Notes:**	
Sampled Name: BLAKE	**Correlated Name:** HAYNIE		**Certification:** Level 2	
Taxonomic Classification: Coarse-silty, mixed, superactive, calcareous, mesic Aquic Udorthents				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxajunct	
SSURGO MU: 72 - BLAKE SILTY CLAY LOAM, OCCASIONALLY FLOODED			**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association	
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part			**CRA:** M115B.3 - Missouri River Alluvial Plain	
County/SSA: MO183 - ST CHARLES, MO, USA			**7.5' Quad:** 38090-G1 - Wood River, Illinois	
Lat/Long: 38° 49’ 31.7” N, 90° 7’ 12.8” W			**UTM:** 749,998 E, 4,301,350N -- NAD83 , Zone 15	
Legal: 321 ft West and 2,822 ft North from the South East corner of S9, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley			**Landform:** flood-plain step	
Geomorphic Component: Tread			**Profile Position:** N/A	
Elevation: 412 ft	**Aspect:** 202°		**Slope:** 1%	**Shape:** up/down: Linear - across: Linear
Flooding: frequent;			**Ponding:** none	
Drainage: Moderately well drained	**Runoff:** Negligible	**Perm:** Moderate	**Ksat:**	**Erosion:** None - deposition
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, silty, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage				

Particle Size Control Section: 10-40" (25-102cm); 10% Clay
Diagnostic Horizons and Restrictions: Ochric epipedon: 0 to 8 inches (0-20 cm) Aquic conditions: 19 to 65 inches (48-165 cm)

HAYNIE **M0318309**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 3 inches (0-8 cm); dark yellowish brown (10YR 4/4, broken face) silt loam; moderate fine subangular blocky structure; friable; common fine roots throughout; many fine interstitial pores; Note: Slight effervescence.; clear smooth boundary.

A --- 3 to 8 inches (8-20 cm); very dark grayish brown (10YR 3/2, broken face) silt loam; massive structure; friable; common fine roots throughout; many fine interstitial pores; Note: Slight effervescence.; clear smooth boundary.

C1 --- 8 to 19 inches (20-48 cm); 70% dark brown (10YR 3/3, broken face) , and 30% yellowish brown (10YR 5/4, broken face) silt loam; massive structure; friable; common fine roots throughout; many fine interstitial pores; few yellowish brown (10YR 5/6) fine distinct masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Slight effervescence. Fine and medium bedding planes.; clear smooth boundary.

C2 --- 19 to 38 inches (48-97 cm); 50% light yellowish brown (2.5Y 6/4, broken face) , and 50% light olive brown (2.5Y 5/3, broken face) silt loam; massive structure; friable; common fine roots throughout; many fine interstitial pores; few light brownish gray (10YR 6/2) fine prominent iron depletions on faces of peds; Note: Strong effervescence. Very fine bedding planes.; clear smooth boundary.

Cg --- 38 to 47 inches (97-119 cm); 50% brown (10YR 5/3, broken face) , and 50% grayish brown (2.5Y 5/2, broken face) silt loam; weak fine subangular blocky structure; friable; many fine interstitial pores; few yellowish brown (10YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Slight effervescence. Thin bedding planes.; clear smooth boundary.

C --- 47 to 60 inches (119-152 cm); 60% brown (10YR 5/3, broken face) , and 40% yellowish brown (10YR 5/4, broken face) fine sand; single grain structure; loose; many fine interstitial pores; few strong brown (7.5YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Non-effervescent; abrupt smooth boundary.

Cg’ --- 60 to 65 inches (152-165 cm); 50% grayish brown (10YR 5/2, broken face) , and 50% dark grayish brown (10YR 4/2, broken face) silty clay; massive structure; firm; common fine tubular pores; few strong brown (7.5YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few brown (10YR 4/3) fine distinct masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Slight effervescence. Fine and medium bedding planes.; abrupt smooth boundary.

C --- 65 to 83 inches (165-211 cm); 34% pale brown (10YR 6/3, broken face) , 33% yellowish brown (10YR 5/4, broken face) , and 33% brown (10YR 4/3, broken face) stratified silt loam; massive structure; friable; few fine tubular pores; Note: Strong effervescence. Thin bedding planes..

Site ID: Name this Site Here		**Lab ID:** MCL M0318310		
Special Project: Confluence State Park				
Description Date: 8/21/2003		**Print Date:** 9/28/2006		
Describers Name(s): Dennis Meinert				
Site Notes:		**Pedon Notes:**		
Sampled Name: WALDRON	**Correlated Name:** WABASH		**Certification:** Level 2	
Taxonomic Classification: Fine, smectitic, superactive, calcareous, mesic Cumulic Vertic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Series	
SSURGO MU: 71 - WALDRON SILTY CLAY, OCCASIONALLY FLOODED		**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association		
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part		**CRA:** M115B.3 - Missouri River Alluvial Plain		
County/SSA: MO183 - ST CHARLES, MO, USA		**7.5' Quad:** 38090-G1 - Wood River, Illinois		
Lat/Long: 38° 49' 29" N, 90° 7' 17.9" W		**UTM:** 749,878 E, 4,301,262N -- NAD83 , Zone 15		
Legal: 715 ft West and 2,533 ft North from the South East corner of S9, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley		**Landform:** flood-plain step		
Geomorphic Component: Tread		**Profile Position:** N/A		
Elevation: 410 ft	**Aspect:** 45°	**Slope:** 1%	**Shape:** up/down: Linear - across: Concave	
Flooding: frequent; brief		**Ponding:** occasional; brief		
Drainage: Somewhat poorly drained	**Runoff:** Negligible	**Perm:** Slow	**Ksat:**	**Erosion:** None - deposition
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, silty and clayey, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage				

Particle Size Control Section: 10-40" (25-102cm); 46% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 40 inches (0-102 cm) Aquic conditions: 13 to 84 inches (33-213 cm)

WABASH **M0318310**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 6 inches (0-15 cm); very dark gray (10YR 3/1, broken face) loam; moderate fine and medium subangular blocky structure; noneffervescent (HCl, 1 normal); very friable; many fine roots throughout; many fine tubular pores; gradual smooth boundary.

A --- 6 to 13 inches (15-33 cm); very dark gray (10YR 3/1, broken face) silty clay loam; moderate medium subangular blocky structure; noneffervescent (HCl, 1 normal); firm; common fine roots throughout; common fine tubular pores; clear smooth boundary.

Bg1 --- 13 to 21 inches (33-53 cm); very dark gray (10YR 3/1, broken face) silty clay loam; moderate fine angular blocky structure; very slightly effervescent (HCl, 1 normal); firm; common fine roots throughout; many very fine tubular, many fine tubular, many medium tubular pores; few dark grayish brown (10YR 4/2) fine faint masses of oxidized iron (fe+3) accumulation on faces of peds, few red (2.5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Few fine and medium bedding planes mixed with sbk structure.; clear smooth boundary.

Bg2 --- 21 to 30 inches (53-76 cm); very dark gray (10YR 3/1, broken face) silty clay; moderate fine angular blocky structure; strongly effervescent (HCl, 1 normal); firm; common fine roots throughout; common fine tubular pores; few strong brown (7.5YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Upper portion of split horizon.; clear smooth boundary.

Bg3 --- 30 to 40 inches (76-102 cm); very dark gray (10YR 3/1, broken face) silty clay; moderate fine angular blocky structure; strongly effervescent (HCl, 1 normal); firm; common fine roots throughout; common fine tubular pores; few strong brown (7.5YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Lower portion of split horizon. ; clear smooth boundary.

Bg4 --- 40 to 51 inches (102-130 cm); dark gray (10YR 4/1, broken face) silty clay; moderate medium angular blocky structure; slightly effervescent (HCl, 1 normal); firm; common fine roots throughout; common fine tubular pores; few brown (7.5YR 5/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

Bg5 --- 51 to 67 inches (130-170 cm); 50% dark grayish brown (2.5Y 4/2, broken face) , 40% dark gray (2.5Y 4/1, broken face) , and 10% very dark gray (10YR 3/1, broken face) silty clay; weak medium prismatic structure; strongly effervescent (HCl, 1 normal); firm; common fine roots throughout; few fine tubular pores; few dark yellowish brown (10YR 3/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few dark yellowish brown (10YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Iron masses located in interior of peds. Thin bedding planes.; clear smooth boundary.

Bg6 --- 67 to 74 inches (170-188 cm); dark gray (2.5Y 4/1, broken face) silty clay; weak medium prismatic structure; strongly effervescent (HCl, 1 normal); firm; common fine roots throughout; few fine tubular pores; few strong brown (7.5YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note: Iron masses located in interior of peds. Thin bedding planes.; clear smooth boundary.

Cg --- 74 to 84 inches (188-213 cm); dark grayish brown (2.5Y 4/2, broken face) very fine sandy loam; massive structure; slightly effervescent (HCl, 1 normal); very friable; few pinkish gray (7.5YR 6/2) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few dark gray (2.5Y 4/1) fine faint masses of oxidized iron (fe+3) accumulation on faces of peds.

Site ID: Name this Site Here			**Lab ID:** MCL M0318311	
Special Project: Confluence State Park				
Description Date: 5/20/2003			**Print Date:** 9/28/2006	
Describers Name(s): Dennis Meinert, Ralph Tucker, Grant Butler				
Site Notes:			**Pedon Notes:**	
Sampled Name: HAYNIE	**Correlated Name:** PARKVILLE		**Certification:** Level 2	
Taxonomic Classification: Coarse-loamy, mixed, superactive, calcareous, mesic Aquertic Hapludolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind: Taxajunct**	
SSURGO MU: 73 - HAYNIE SILT LOAM, RARELY FLOODED			**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association	
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part			**CRA:** M115B.3 - Missouri River Alluvial Plain	
County/SSA: MO183 - ST CHARLES, MO, USA			**7.5' Quad:** 38090-G1 - Wood River, Illinois	
Lat/Long: 38° 49' 40.1" N, 90° 7' 26.6" W			**UTM:** 749,657 E, 4,301,599N -- NAD83 , Zone 15	
Legal: 1,618 ft East and 3,211 ft South from the North West corner of S9, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley			**Landform:** flood-plain step	
Geomorphic Component: Riser			**Profile Position:** N/A	
Elevation: 410 ft	**Aspect:** 205°		**Slope:** 5%	**Shape:** up/down: Convex - across: Convex
Flooding: frequent; brief			**Ponding:** none	
Drainage: Moderately well drained	**Runoff:** Negligible	**Perm:** Moderate	**Ksat:**	**Erosion:** None - deposition
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, silty, Holocene Stage alluvium from mixed materials over slightly weathered, sandy and silty, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				

Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage
Particle Size Control Section: 10-40" (25-102cm); 15% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 17 inches (0-43 cm) Aquic conditions: 32 to 44 inches (81-112 cm)

PARKVILLE **M0318311**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 5 inches (0-13 cm); very dark gray (10YR 3/1, broken face) silty clay loam; weak fine subangular blocky structure; very friable; common fine roots throughout, and common medium roots throughout; common fine vesicular pores; abrupt smooth boundary.

A --- 5 to 17 inches (13-43 cm); very dark gray (10YR 3/1, broken face) silty clay loam; weak fine subangular blocky structure; friable; common fine roots throughout, and common medium roots throughout; common very fine vesicular, common fine vesicular pores; gradual wavy boundary.

Cg1 --- 17 to 26 inches (43-66 cm); dark gray (10YR 4/1, broken face) stratified silt loam; massive structure; friable; common fine roots throughout; common very fine vesicular, common fine vesicular pores; abrupt wavy boundary.

Cg2 --- 26 to 32 inches (66-81 cm); grayish brown (10YR 5/2, broken face) stratified loamy fine sand; massive structure; friable; common very fine roots throughout, and common fine roots throughout; common very fine interstitial pores; abrupt wavy boundary.

Cg3 --- 32 to 41 inches (81-104 cm); very dark gray (10YR 3/1, broken face) stratified loam; massive structure; friable; common fine roots throughout; common very fine vesicular, common fine vesicular pores; few strong brown (7.5YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt wavy boundary.

Cg4 --- 41 to 44 inches (104-112 cm); very dark grayish brown (10YR 3/2, broken face) stratified silt loam; massive structure; firm; common very fine roots throughout, and common fine roots throughout; common very fine vesicular, common fine vesicular pores; few light brownish gray (10YR 6/2) distinct silt coats on all faces of peds; few yellowish red (5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt wavy boundary.

Cg5 --- 44 to 68 inches (112-173 cm); dark grayish brown (10YR 4/2, broken face) stratified loam; massive structure; friable; common very fine roots throughout, and common fine roots throughout; common very fine vesicular pores; few light brownish gray (10YR 6/2) distinct silt

coats on all faces of peds; Note: Sampled from 112-142cm (loam) and 142-173cm (very fine sandy loam). ; abrupt wavy boundary.

Cg6 --- 68 to 74 inches (173-188 cm); grayish brown (10YR 5/2, broken face) stratified fine sand; massive structure; friable; common fine interstitial pores; abrupt wavy boundary.

Cg7 --- 74 to 82 inches (188-208 cm); dark grayish brown (10YR 4/2, broken face) stratified very fine sandy loam; massive structure; friable; common very fine vesicular pores.

Site ID: Name this Site Here		**Lab ID:** MCL M0418301		
Special Project: Confluence State Park				
Description Date: 3/22/2004		**Print Date:** 10/16/2006		
Describers Name(s): Keith Knelle, Dennis Meinert				
Site Notes:		**Pedon Notes:**		
Sampled Name: WALDRON	**Correlated Name:** PARKVILLE		**Certification:** Level 2	
Taxonomic Classification: Coarse-silty, smectitic, superactive, calcareous, mesic Aquertic Hapludolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxajunct	
SSURGO MU: 71 - WALDRON SILTY CLAY, OCCASIONALLY FLOODED		**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association		
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part		**CRA:** M115B.3 - Missouri River Alluvial Plain		
County/SSA: MO183 - ST CHARLES, MO, USA		**7.5' Quad:** 38090-G2 - Columbia Bottom, Missouri		
Lat/Long: 38° 50' 33.6" N, 90° 7' 49.5" W		**UTM:** 749,054 E, 4,303,232N -- NAD83 , Zone 15		
Legal: 360 ft West and 2,146 ft North from the South East corner of S5, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley		**Landform:** flood-plain step		
Geomorphic Component: Tread		**Profile Position:** N/A		
Elevation: 416 ft	**Aspect:** 225°	**Slope:** 1%	**Shape:** up/down: Linear - across: Linear	
Flooding: frequent; brief		**Ponding:** none		
Drainage: Somewhat poorly drained	**Runoff:** Negligible	**Perm:** Slow	**Ksat:**	**Erosion:** None - deposition - Gully erosion
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, clayey, Holocene Stage alluvium from mixed materials over slightly weathered, sandy and silty, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				

Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage
Particle Size Control Section: 10-40" (25-102cm); 8% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 11 inches (0-28 cm) Aquic conditions: 11 to 80 inches (28-203 cm)

PARKVILLE **M0418301**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 11 inches (0-28 cm); very dark gray (10YR 3/1), broken face; silty clay; moderate medium angular blocky structure; very firm; common fine roots throughout, and common medium roots throughout; common fine tubular, common medium tubular pores; clear smooth boundary.

C1 --- 11 to 21 inches (28-53 cm); 50% olive brown (2.5Y 4/3) broken face, and 50% light olive brown (2.5Y 5/3) broken face; stratified fine sandy loam; massive structure; very friable; common fine roots throughout; common fine interstitial pores; few dark yellowish brown (10YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt smooth boundary.

C2 --- 21 to 28 inches (53-71 cm); 50% olive brown (2.5Y 4/3, broken face) , and 50% light olive brown (2.5Y 5/3, broken face) stratified very fine sandy loam; massive structure; very friable; common fine roots throughout; common fine interstitial pores; few dark yellowish brown (10YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note(s): Small 5cm plow layer present at top of horizon.; clear smooth boundary.

C3 --- 28 to 49 inches (71-124 cm); 50% olive brown (2.5Y 4/3, broken face) , and 50% light olive brown (2.5Y 5/3, broken face) stratified very fine sandy loam; massive structure; very friable; common fine roots throughout; common fine interstitial pores; few dark yellowish brown (10YR 3/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

C4 --- 49 to 54 inches (124-137 cm); 50% olive brown (2.5Y 4/3, broken face) , and 50% dark grayish brown (2.5Y 4/2, broken face) stratified very fine sandy loam; massive structure; very friable; common fine roots throughout; few fine interstitial pores; few dark yellowish brown (10YR 3/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

C5 --- 54 to 61 inches (137-155 cm); 50% olive brown (2.5Y 4/3, broken face) , and 50% light olive brown (2.5Y 5/3, broken face) silt loam; massive structure; friable; common fine roots

throughout; common fine tubular pores; few dark yellowish brown (10YR 3/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt smooth boundary.

Cg --- 61 to 80 inches (155-203 cm); 40% dark gray (2.5Y 4/1, broken face) , 40% gray (2.5Y 5/1, broken face) , and 20% very dark gray (2.5Y 3/1, broken face) stratified silt loam; massive structure; friable; common fine interstitial, common medium interstitial, common fine tubular, common medium tubular pores; few gray (2.5Y 6/1) distinct silt coats on all faces of peds; few dark yellowish brown (10YR 3/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few fine faint masses of iron-manganese accumulation.

Site ID: Name this Site Here		**Lab ID:** MCL M0418302		
Special Project: Confluence State Park				
Description Date: 3/22/2004		**Print Date:** 10/16/2006		
Describers Name(s): Keith Knelle, Dennis Meinert				
Site Notes:		**Pedon Notes:**		
Sampled Name: WALDRON	**Correlated Name:** LEVASY		**Certification:** Level 2	
Taxonomic Classification: Clayey over sandy or sandy-skeletal, smectitic, superactive, calcareous, mesic Cumulic Vertic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxajunct	
SSURGO MU: 71 - WALDRON SILTY CLAY, OCCASIONALLY FLOODED		**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association		
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part		**CRA:** M115B.3 - Missouri River Alluvial Plain		
County/SSA: MO183 - ST CHARLES, MO, USA		**7.5' Quad:** 38090-G2 - Columbia Bottom, Missouri		
Lat/Long: 38° 50' 41.8" N, 90° 7' 46.1" W		**UTM:** 749,129 E, 4,303,486N -- NAD83 , Zone 15		
Legal: 114 ft West and 2,979 ft North from the South East corner of S5, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley		**Landform:** flood-plain step		
Geomorphic Component: Tread		**Profile Position:** N/A		
Elevation: 416 ft	**Elevation:** 416 ft	**Slope:** 0.5%	**Shape:** up/down: Linear - across: Linear	
Flooding: frequent; brief		**Ponding:** rare; very brief		
Drainage: Poorly drained	**Runoff:** Negligible	**Perm:** Slow	**Ksat:**	**Erosion:** None - deposition - Gully erosion
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, clayey, Holocene Stage alluvium from mixed materials over slightly weathered, sandy and silty, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				

Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage
Particle Size Control Section: 10-40" (25-102cm); 40% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 38 inches (0-97 cm) Aquic conditions: 4 to 80 inches (10-203 cm)

LEVASY **M0418302**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 11 inches (0-28 cm); very dark gray (10YR 3/1, broken face) silty clay; moderate medium angular blocky structure; very firm; common fine roots throughout, and common medium roots throughout; common fine tubular, common medium tubular pores; clear smooth boundary.

C1 --- 11 to 21 inches (28-53 cm); 50% olive brown (2.5Y 4/3, broken face) , and 50% light olive brown (2.5Y 5/3, broken face) stratified fine sandy loam; massive structure; very friable; common fine roots throughout; common fine interstitial pores; few dark yellowish brown (10YR 4/6) fine prominent masses of oxidized iron (fe+3)
accumulation on faces of peds; abrupt smooth boundary.

C2 --- 21 to 28 inches (53-71 cm); 50% olive brown (2.5Y 4/3, broken face) , and 50% light olive brown (2.5Y 5/3, broken face) stratified very fine sandy loam; massive structure; very friable; common fine roots throughout; common fine interstitial pores; few dark yellowish brown (10YR 4/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note(s): Small 5cm plow layer present at top of horizon.; clear smooth boundary.

C3 --- 28 to 49 inches (71-124 cm); 50% olive brown (2.5Y 4/3, broken face) , and 50% light olive brown (2.5Y 5/3, broken face) stratified very fine sandy loam; massive structure; very friable; common fine roots throughout; common fine interstitial pores; few dark yellowish brown (10YR 3/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

C4 --- 49 to 54 inches (124-137 cm); 50% olive brown (2.5Y 4/3, broken face) , and 50% dark grayish brown (2.5Y 4/2, broken face) stratified very fine sandy loam; massive structure; very friable; common fine roots throughout; few fine interstitial pores; few dark yellowish brown (10YR 3/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

C5 --- 54 to 61 inches (137-155 cm); 50% olive brown (2.5Y 4/3, broken face) , and 50% light olive brown (2.5Y 5/3, broken face) silt loam; massive structure; friable; common fine roots

throughout; common fine tubular pores; few dark yellowish brown (10YR 3/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt smooth boundary.

Cg --- 61 to 80 inches (155-203 cm); 40% dark gray (2.5Y 4/1, broken face) , 40% gray (2.5Y 5/1, broken face) , and 20% very dark gray (2.5Y 3/1, broken face) stratified silt loam; massive structure; friable; common fine interstitial, common medium interstitial, common fine tubular, common medium tubular pores; few gray (2.5Y 6/1) distinct silt coats on all faces of peds; few dark yellowish brown (10YR 3/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few fine faint masses of iron-manganese accumulation.

Site ID: Name this Site Here		**Lab ID:** MCL M0418303		
Special Project: Confluence State Park				
Description Date: 3/22/2004		**Print Date:** 10/16/2006		
Print Date: 10/16/2006				
Site Notes:		**Pedon Notes:**		
Sampled Name: WALDRON	**Correlated Name:** LEVASY		**Certification:** Level 2	
Taxonomic Classification: Fine, smectitic, superactive, calcareous, mesic Cumulic Vertic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxadjunct	
SSURGO MU: 71 - WALDRON SILTY CLAY, OCCASIONALLY FLOODED		**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association		
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part		**CRA:** M115B.3 - Missouri River Alluvial Plain		
County/SSA: MO183 - ST CHARLES, MO, USA		**7.5' Quad:** 38090-G2 - Columbia Bottom, Missouri		
Lat/Long: 38° 50' 48" N, 90° 7' 46.9" W		**UTM:** 749,102 E, 4,303,678N -- NAD83 , Zone 15		
Legal: 203 ft West and 3,609 ft North from the South East corner of S5, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley		**Landform:** flood-plain step		
Geomorphic Component: Tread		**Profile Position:** N/A		
Elevation: 416 ft	**Aspect:** 0°	**Slope:** 0.5%	**Shape:** up/down: Linear - across: Linear	
Shape: up/down: Linear - across: Linear		**Ponding:** rare; very brief		
Drainage: Poorly drained	**Runoff:** Negligible	**Perm:** Moderately slow	**Ksat:**	**Erosion:** None - deposition - Gully erosion
Erosion: None - deposition - Gully erosion				
Parent Materials: Slightly weathered, clayey, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage				

Particle Size Control Section: 10-40" (25-102cm); 35% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 45 inches (0-114 cm) Aquic conditions: 4 to 80 inches (10-203 cm)

SAMPLED AS LEVASY **MO318303**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 4 inches (0-10 cm); very dark gray (10YR 3/1, broken face) silty clay; weak fine granular structure; friable; common fine roots throughout, and common medium roots throughout; common fine irregular pores; gradual smooth boundary.

A --- 4 to 12 inches (10-30 cm); very dark gray (10YR 3/1, broken face) silty clay; weak fine subangular blocky structure; very firm; common fine roots throughout, and common medium roots throughout; common fine tubular, common medium tubular pores; very few gray (10YR 6/1) faint silt coats on all faces of peds; few dark yellowish brown (10YR 4/4) medium prominent masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

Bg1 --- 12 to 20 inches (30-51 cm); very dark gray (10YR 3/1, broken face) silty clay; moderate fine and medium subangular blocky structure; very firm; common fine roots throughout, and common medium roots throughout; common fine tubular, common medium tubular pores; few dark yellowish brown (10YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

Bg2 --- 20 to 29 inches (51-74 cm); 60% dark gray (10YR 4/1, broken face) , and 40% very dark gray (10YR 3/1, broken face) silty clay loam; moderate fine and medium subangular blocky structure; firm; common fine roots throughout; common fine tubular, common medium tubular pores; few dark yellowish brown (10YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note(s): Mixed color: 10YR 3/2; clear smooth boundary.

Bg3 --- 29 to 45 inches (74-114 cm); 60% dark gray (10YR 4/1, broken face) , and 40% very dark grayish brown (2.5Y 3/2, broken face) silt loam; moderate fine and medium subangular blocky structure; friable; common fine roots throughout; common fine tubular pores; few yellowish brown (10YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few very dark gray (10YR 3/1) fine distinct masses of iron-manganese accumulation on faces of peds; Note(s): Mixed color: 10YR 3/3; clear smooth boundary.

Cg1 --- 45 to 57 inches (114-145 cm); 70% grayish brown (10YR 5/2, broken face) , and 30% very dark grayish brown (10YR 3/2, broken face) silt loam; massive structure; friable; common fine roots throughout; common fine tubular pores; few dark yellowish brown (10YR 4/6) fine

prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note(s): Mixed color: 10YR 4/2; abrupt smooth boundary.

Cg2 --- 57 to 80 inches (145-203 cm); 34% very dark gray (2.5Y 3/1, broken face) , 33% gray (2.5Y 5/1, broken face) , and 33% dark grayish brown (2.5Y 4/2, broken face) stratified very fine sandy loam; massive structure; friable; common fine tubular pores; few dark yellowish brown (10YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few very dark gray (10YR 3/1) fine distinct masses of iron-manganese accumulation on faces of peds.

Site ID: Name this Site Here			**Lab ID:** MCL M0418304	
Special Project: Confluence State Park				
Description Date: 3/22/2004			**Print Date:** 10/16/2006	
Describers Name(s): Keith Knelle, Dennis Meinert				
Site Notes:			**Pedon Notes:**	
Sampled Name: WALDRON	**Correlated Name:** TIEVILLE		**Certification:** Level 2	
Taxonomic Classification: Fine-silty, mixed, superactive, calcareous, mesic Cumulic Vertic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxadjunct	
SSURGO MU: 71 - WALDRON SILTY CLAY, OCCASIONALLY FLOODED			**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association	
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part			**CRA:** M115B.3 - Missouri River Alluvial Plain	
County/SSA: MO183 - ST CHARLES, MO, USA			**7.5' Quad:** 38090-G2 - Columbia Bottom, Missouri	
Lat/Long: 38° 50' 46.6" N, 90° 7' 33.1" W			**UTM:** 749,438 E, 4,303,643N -- NAD83 , Zone 15	
Legal: 899 ft East and 3,495 ft North from the South West corner of S4, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley			**Landform:** flood-plain step	
Geomorphic Component: Trader			**Profile Position:** N/A	
Elevation: 416 ft	**Aspect:** 0°		**Slope:** 0.5%	**Shape:** up/down: Linear - across: Linear
Flooding: frequent; brief			**Ponding:** rare; very brief	
Drainage: Somewhat poorly drained	**Runoff:** Negligible	**Perm:** Moderately slow	**Ksat:**	**Erosion:** None - deposition - Gully erosion
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, clayey, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage				

Particle Size Control Section: 10-40" (25-102cm); 34% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 48 inches (0-122 cm) Aquic conditions: 12 to 70 inches (30-178 cm)

SAMPLED AS TIEVILLE **MO318304**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 4 inches (0-10 cm); very dark gray (10YR 3/1, broken face) silty clay; weak fine granular structure; friable; common fine roots throughout, and common medium roots throughout; common fine interstitial, common medium interstitial pores; gradual smooth boundary.
A --- 4 to 12 inches (10-30 cm); very dark gray (10YR 3/1, broken face) silty clay; moderate fine and medium wedge structure; very firm; common fine roots throughout, and common medium roots throughout; common fine tubular, common medium tubular pores; common very dark gray (10YR 3/1) distinct slickensides on all faces of peds; gradual smooth boundary.

Bg1 --- 12 to 25 inches (30-64 cm); very dark gray (2.5Y 3/1, broken face) silty clay loam; weak fine subangular blocky structure; firm; common fine roots throughout, and common medium roots throughout; common fine tubular pores; very few very dark grayish brown (2.5Y 3/2) faint clay films on all faces of peds; few strong brown (7.5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

Bg2 --- 25 to 36 inches (64-91 cm); very dark gray (2.5Y 3/1, broken face) silty clay loam; weak fine subangular blocky structure; firm; common fine roots throughout; common fine tubular pores; very few light gray (10YR 7/1) distinct silt coats on all faces of peds; few dark yellowish brown (10YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

Bg3 --- 36 to 48 inches (91-122 cm); 60% very dark gray (10YR 3/1, broken face) , and 40% dark grayish brown (2.5Y 4/2, broken face) silty clay loam; weak fine subangular blocky structure; firm; common fine roots throughout; common fine tubular pores; very few light gray (10YR 7/1) distinct silt coats on all faces of peds; few dark yellowish brown (10YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt smooth boundary.

Cg1 --- 48 to 55 inches (122-140 cm); dark grayish brown (10YR 4/2, broken face) silt loam; massive structure; friable; common fine roots throughout; common fine tubular pores; few dark yellowish brown (10YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

Cg2 --- 55 to 60 inches (140-152 cm); light brownish gray (2.5Y 6/2, broken face) fine sand; massive structure; very friable; few fine tubular pores; gradual smooth boundary.

Cg3 --- 60 to 61 inches (152-155 cm); 50% grayish brown (2.5Y 5/2, broken face) , and 50% light brownish gray (2.5Y 6/2, broken face) stratified very fine sandy loam; massive structure; very friable; few fine tubular pores.

Site ID: Name this Site Here			**Lab ID:** MCL M0418305	
Special Project: Confluence State Park				
Description Date: 3/22/2004			**Print Date:** 10/16/2006	
Describers Name(s): Keith Knelle, Dennis Meinert				
Site Notes:			**Pedon Notes:**	
Sampled Name: WALDRON	**Correlated Name:** WABASH		**Correlated Name:** WABASH	
Taxonomic Classification: Fine, smectitic, superactive, calcareous, mesic Vertic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxadjunct	
SSURGO MU: 71 - WALDRON SILTY CLAY, OCCASIONALLY FLOODED			**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association	
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part			**CRA:** M115B.3 - Missouri River Alluvial Plain	
County/SSA: MO183 - ST CHARLES, MO, USA			**7.5' Quad:** 38090-G1 - Wood River, Illinois	
Lat/Long: 38° 50’ 9.5” N, 90° 7’ 23.1” W			**UTM:** 749,713 E, 4,302,509N -- NAD83 , Zone 15	
Legal: 1,802 ft East and 226 ft South from the North West corner of S9, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley			**Landform:** flood-plain step	
Geomorphic Component: Trader			**Profile Position:** N/A	
Elevation: 410 ft	**Aspect:** 0°		**Slope:** 0.5%	**Shape:** up/down: Linear - across: Linear
Flooding: frequent; brief			**Ponding:** occasional; brief	
Drainage: Somewhat poorly drained	**Runoff:** Negligible	**Perm:** Slow	**Perm:** Slow	**Erosion:** None - deposition - Gully erosion
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, silty and clayey, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage				

Particle Size Control Section: 10-40" (25-102cm); 53% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 12 inches (0-30 cm) Aquic conditions: 4 to 75 inches (10-190 cm) Cambic horizon: 12 to 63 inches (30-160 cm)

SAMPLED AS WABASH MO318305

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 4 inches (0-10 cm); very dark gray (10YR 3/1, broken face) clay loam; weak fine granular structure; friable; common fine roots throughout, and common medium roots throughout; common fine tubular, common medium tubular pores; clear smooth boundary.

A --- 4 to 12 inches (10-30 cm); very dark gray (10YR 3/1, broken face) silty clay; moderate medium subangular blocky structure; very firm; common fine roots throughout, and common medium roots throughout; few fine tubular pores; common strong brown (7.5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, common black (10YR 2/1) medium faint masses of iron-manganese accumulation on faces of peds.

Bg1 --- 12 to 28 inches (30-71 cm); dark gray (2.5Y 4/1, broken face) silty clay; strong coarse subangular blocky structure; very firm; common fine roots throughout, and common medium roots throughout; common fine tubular pores; very few very dark gray (10YR 3/1) faint clay films on all faces of peds; common strong brown (7.5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, common black (10YR 2/1) medium faint masses of iron-manganese accumulation on faces of peds; clear smooth boundary.

Bg1 --- 28 to 53 inches (71-135 cm); 80% dark gray (2.5Y 4/1, broken face) , and 20% dark gray (N 4/0, broken face) silty clay; moderate fine and medium subangular blocky structure; very firm; common fine roots throughout; common fine tubular, common medium tubular pores; common very dark gray (2.5Y 3/1) faint clay films on all faces of peds, few light brownish gray (10YR 6/2) prominent silt coats on all faces of peds; common dark red (2.5YR 3/6) coarse prominent masses of oxidized iron (fe+3) accumulation on vertical faces of peds, common strong brown (7.5YR 4/6) medium prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few very dark gray (10YR 3/1) fine faint masses of iron-manganese accumulation on faces of peds; clear smooth boundary.

Bg2 --- 53 to 63 inches (135-160 cm); very dark gray (2.5Y 3/1, broken face) silty clay loam; strong coarse subangular blocky structure; firm; common fine tubular, common medium tubular pores; few very dark gray (N 3/0) faint clay films on all faces of peds; common dark red (2.5YR 3/6) coarse prominent masses of oxidized iron (fe+3) accumulation on vertical faces of peds, few strong brown (7.5YR 5/8) medium prominent masses of oxidized iron (fe+3) accumulation

on faces of peds, few black (10YR 2/1) fine faint masses of iron-manganese accumulation on faces of peds; clear smooth boundary.

Cg1 --- 63 to 68 inches (160-173 cm); gray (10YR 5/1, broken face) stratified silty clay loam; massive structure; very friable; common fine tubular pores; common strong brown (7.5YR 4/6) medium prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few black (10YR 2/1) fine faint masses of iron-manganese accumulation on faces of peds; abrupt smooth boundary.

C1 --- 68 to 74 inches (173-188 cm); brown (10YR 4/3, broken face) stratified silt loam; single grain structure; very friable; common fine interstitial pores; few strong brown (7.5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt smooth boundary.

C2 --- 74 to 75 inches (188-190 cm); 70% dark yellowish brown (10YR 4/4, broken face) , and 30% gray (10YR 5/1, broken face) stratified fine sand; massive structure; friable; common strong brown (7.5YR 4/6) medium prominent masses of oxidized iron (fe+3) accumulation on faces of peds.

Site ID: Name this Site Here		**Lab ID:** MCL M0418306		
Special Project: Confluence State Park				
Description Date: 3/22/2004		**Print Date:** 10/16/2006		
Describers Name(s): Keith Knelle, Dennis Meinert				
Site Notes:		**Pedon Notes:**		
Sampled Name: BLAKE	**Correlated Name:** BLAKE -		**Certification:** Level 2	
Taxonomic Classification: Fine-silty, mixed, superactive, calcareous, mesic Mollic Fluvaquents				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxadjunct	
SSURGO MU: 72 - BLAKE SILTY CLAY LOAM, OCCASIONALLY FLOODED		**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association		
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part		**CRA:** M115B.3 - Missouri River Alluvial Plain		
County/SSA: MO183 - ST CHARLES, MO, USA		**7.5' Quad:** 38090-G2 - Columbia Bottom, Missouri		
Lat/Long: 38° 49' 49.7" N, 90° 8' 9.2" W		**UTM:** 748,621 E, 4,301,863N -- NAD83 , Zone 15		
Legal: 1,781 ft West and 2,345 ft South from the North East corner of S8, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley		**Landform:** flood-plain step		
Geomorphic Component: Trader		**Profile Position:** N/A		
Elevation: 420 ft	**Aspect:** 180°	**Slope:** 2%	**Shape:** up/down: Convex - across: Linear	
Flooding: frequent; brief		**Ponding:** none		
Drainage: Somewhat poorly drained	**Runoff:** Negligible	**Perm:** Moderately slow	**Ksat:**	**Erosion:** None - deposition - Gully erosion
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, sandy and silty, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage				

Particle Size Control Section: 10-40" (25-102cm); 20% Clay
Diagnostic Horizons and Restrictions: Ochric epipedon: 0 to 18 inches (0-46 cm) Aquic conditions: 18 to 80 inches (46-203 cm)

SAMPLED AS BLAKE **MO318306**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 6 inches (0-15 cm); very dark gray (10YR 3/1, broken face) loam; weak fine granular structure; very friable; common fine roots throughout, and common medium roots throughout; common fine interstitial, common medium interstitial pores; gradual smooth boundary.

AB --- 6 to 18 inches (15-46 cm); 90% very dark gray (10YR 3/1, broken face) , and 10% very dark grayish brown (10YR 3/2, broken face) loam; weak fine subangular blocky structure; friable; common fine roots throughout, and common medium roots throughout; common fine tubular pores; clear smooth boundary.

Cg1 --- 18 to 27 inches (46-69 cm); 80% very dark gray (10YR 3/1, broken face) , and 20% dark grayish brown (10YR 4/2, broken face) stratified silty clay loam; massive structure; firm; common fine roots throughout; common fine tubular pores; common very dark gray (10YR 3/1) distinct pressure faces on all faces of peds, few grayish brown (10YR 5/2) faint silt coats on all faces of peds; few strong brown (7.5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note(s): The darker material has angular blocky structure. ; clear smooth boundary.

Cg2 --- 27 to 37 inches (69-94 cm); dark gray (10YR 4/1, broken face) stratified silt loam; massive structure; friable; common fine roots throughout; common fine tubular pores; few dark grayish brown (10YR 4/2) faint silt coats on all faces of peds; few strong brown (7.5YR 4/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

Cg3 --- 37 to 50 inches (94-127 cm); dark gray (10YR 4/1, broken face) stratified silt loam; massive structure; friable; common fine roots throughout; common fine tubular pores; few grayish brown (10YR 5/2) distinct sand coats on all faces of peds; few dark yellowish brown (10YR 3/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

Cg4 --- 50 to 58 inches (127-147 cm); dark gray (10YR 4/1, broken face) stratified fine sand; massive structure; very friable; common fine roots throughout; common fine interstitial pores; abrupt smooth boundary.

Cg5 --- 58 to 70 inches (147-178 cm); very dark gray (2.5Y 3/1, broken face) stratified loam; massive structure; firm; common fine roots throughout; common fine tubular pores; few dark brown (7.5YR 3/4) medium prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few black (10YR 2/1) fine distinct masses of iron-manganese accumulation on faces of peds; abrupt smooth boundary.

Cg6 --- 70 to 71 inches (178-180 cm); dark grayish brown (2.5Y 4/2, broken face) stratified very fine sandy loam; massive structure; very friable; common fine interstitial pores.

Site ID: Name this Site Here			**Lab ID:** MCL M0418307	
Special Project: Confluence State Park				
Description Date: 3/22/2004			**Print Date:** 10/16/2006	
Describers Name(s): Keith Knelle, Dennis Meinert				
Site Notes:			**Pedon Notes:**	
Sampled Name: BLAKE	**Correlated Name:** BLAKE		**Certification:** Level 2	
Taxonomic Classification: Coarse-silty, mixed, superactive, calcareous, mesic Fluvaquentic Hapludolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxadjunct	
SSURGO MU: 72 - BLAKE SILTY CLAY LOAM, OCCASIONALLY FLOODED			**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association	
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part			**CRA:** M115B.3 - Missouri River Alluvial Plain	
County/SSA: MO183 - ST CHARLES, MO, USA			**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association	
Lat/Long: 38° 49’ 39.4” N, 90° 7’ 48.1” W			**UTM:** 749,141 E, 4,301,560N -- NAD83 , Zone 15	
Legal: 75 ft West and 3,339 ft South from the North West corner of S9, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley			**Landform:** flood-plain step	
Geomorphic Component: Trader			**Profile Position:** N/A	
Elevation: 412 ft	**Aspect:** 71°		**Slope:** 1.5%	**Shape:** up/down: Linear - across: Linear
Flooding: frequent; brief			**Ponding:** none	
Drainage: Moderately well drained	**Runoff:** Negligible	**Perm:** Moderately slow	**Ksat:**	**Erosion:** None - deposition - Gully erosion
Landcover: Crop cover ; Row crop				
Parent Materials: Slightly weathered, sandy and silty, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage				

Particle Size Control Section: 10-40" (25-102cm); 13% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 14 inches (0-36 cm) Aquic conditions: 14 to 73 inches (36-185 cm)

SAMPLED AS BLAKE **MO318307**

Horizon Description **Observation method:** Small Pit

Ap --- 0 to 7 inches (0-18 cm); very dark grayish brown (10YR 3/2, broken face) loam; weak fine granular structure; very friable; common fine roots throughout, and common medium roots throughout; common fine interstitial, common medium interstitial pores; gradual smooth boundary.

A --- 7 to 14 inches (18-36 cm); very dark grayish brown (10YR 3/2, broken face) loam; weak fine granular structure; very friable; common fine roots throughout, and common medium roots throughout; common fine tubular, common medium tubular pores; abrupt smooth boundary.

C1 --- 14 to 26 inches (36-66 cm); 90% dark grayish brown (10YR 4/2, broken face) , and 10% dark gray (10YR 4/1, broken face) stratified very fine sandy loam; massive structure; very friable; common fine roots throughout; common fine interstitial pores; few brown (10YR 4/3) fine faint masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

C2 --- 26 to 36 inches (66-91 cm); dark gray (10YR 4/1, broken face) stratified silt loam; massive structure; friable; common fine roots throughout; common fine tubular, common medium tubular pores; few dark yellowish brown (10YR 3/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt smooth boundary.

C3 --- 36 to 44 inches (91-112 cm); very dark gray (10YR 3/1, broken face) silty clay; massive structure; firm; common fine roots throughout; common fine tubular pores; few black (10YR 2/1) faint clay films on all faces of peds; few dark yellowish brown (10YR 3/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

C4 --- 44 to 58 inches (112-147 cm); very dark gray (10YR 3/1, broken face) silty clay loam; massive structure; firm; common fine tubular pores; few very dark grayish brown (10YR 3/2) faint clay films on all faces of peds; few dark yellowish brown (10YR 3/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

C5 --- 58 to 64 inches (147-163 cm); 80% very dark gray (10YR 3/1, broken face) , and 20% dark grayish brown (10YR 4/2, broken face) stratified silt loam; massive structure; friable; common fine tubular pores; few black (10YR 2/1) faint clay films on all faces of peds; few dark

brown (10YR 3/3) fine faint masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt smooth boundary.

C6 --- 64 to 73 inches (163-185 cm); dark gray (10YR 4/1, broken face) silt loam; massive structure; friable; common fine interstitial pores; few dark yellowish brown (10YR 3/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

C7 --- 73 to 74 inches (185-188 cm); dark grayish brown (10YR 4/2, broken face) silty clay loam; massive structure; friable; common fine tubular pores; few dark brown (10YR 3/3) fine faint masses of oxidized iron (fe+3) accumulation on faces of peds.

Site ID: Name this Site Here			**Lab ID:** MCL M0618351	
Special Project: Confluence State Park				
Description Date: 9/6/2006			**Print Date:** 1/2/2007	
Describers Name(s): Keith Knelle, John Horton				
Site Notes:			**Pedon Notes:**	
Sampled Name: HAYNIE	**Correlated Name:**			**Certification:** Level 2
Taxonomic Classification: Coarse-silty, mixed, superactive, mesic Fluvaquentic Hapludolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description			**Taxon Kind:** Taxajunct
SSURGO MU: 66009 - Haynie silt loam, 0 to 2 percent slopes, occasionally flooded			**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association	
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part			**CRA:** M115B.3 - Missouri River Alluvial Plain	
County/SSA: MO183 - ST CHARLES, MO, USA			**7.5' Quad:** 38090-G1 - Wood River, Illinois	
Lat/Long: 38° 49’ 14.8” N, 90° 7’ 14.8” W			**UTM:** 749,967 E, 4,300,828N -- NAD83 , Zone 15	
Legal: 423 ft West and 1,109 ft North from the South East corner of S9, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau			**US Phys Sec:** Springfield-Salem plateaus
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain			**MO LTA:** OZ15c - West Alton Alluvial Plain
Landscape: river valley			**Landform:** flood-plain step	
Geomorphic Component: Treadr			**Profile Position:** N/A	
Elevation: 410 ft	**Aspect:** 10°		**Slope:** 1%	**Shape:** up/down: Linear - across: Linear
Flooding: occasional; brief			**Ponding:** none	
Drainage: Somewhat poorly drained	**Runoff:** Negligible	**Permeability:** Moderately slow	**Ksat:**	**Erosion:** None - deposition
Landcover: Grass/herbaceous cover ; Other grass/herbaceous cover				
Parent Materials: Slightly weathered, sandy and silty, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage				

Particle Size: Control Section: 10-40" (25-102cm); 11% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 10 inches (0-25 cm) Aquic conditions: 10 to 80 inches (25-203 cm) Cambic horizon: 10 to 23 inches (25-58 cm)

SAMPLED AS BLAKE **MO618351**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 10 inches (0-25 cm); very dark gray (10YR 3/1, broken face) silt loam; moderate fine and medium subangular blocky structure; friable; common very fine roots throughout, and common fine roots throughout; common very fine interstitial, common fine interstitial pores; clear smooth boundary.

CB --- 10 to 23 inches (25-58 cm); dark grayish brown (10YR 4/2, broken face) stratified silt loam; massive and weak fine subangular blocky structure; friable; common very fine roots throughout, and common fine roots throughout; common very fine interstitial, common fine interstitial pores; few strong brown (7.5YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few gray (10YR 5/1) fine faint iron depletions on faces of peds; gradual smooth boundary.

Cg1 --- 23 to 39 inches (58-99 cm); dark grayish brown (10YR 4/2, broken face) stratified silt loam; massive structure; slightly effervescent (HCl, 1 normal); friable; few very fine roots throughout, and few fine roots throughout; common fine tubular pores; few strong brown (7.5YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few gray (10YR 5/1) fine faint iron depletions on faces of peds, few black (10YR 2/1) fine distinct masses of manganese accumulation on faces of peds; clear smooth boundary.

Cg2 --- 39 to 49 inches (99-124 cm); 50% brown (10YR 4/3, broken face) , and 50% dark grayish brown (10YR 4/2, broken face) stratified very fine sandy loam; massive structure; slightly effervescent (HCl, 1 normal); loose; few very fine roots throughout; common fine interstitial pores; few strong brown (7.5YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt smooth boundary.

Cg3 --- 49 to 57 inches (124-145 cm); brown (10YR 4/3, broken face) stratified silt loam; massive structure; slightly effervescent (HCl, 1 normal); friable; few fine tubular pores; few very dark gray (N 3/0) fine prominent iron depletions on faces of peds, common dark reddish brown (2.5YR 3/4) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt smooth boundary.

Cg4 --- 57 to 80 inches (145-203 cm); brown (10YR 4/3, broken face) stratified fine sand;

massive structure; slightly effervescent (HCl, 1 normal); loose; common fine interstitial pores; few strong brown (7.5YR 5/6) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds.

Site ID: Name this Site Here			**Lab ID:** MCL M0618352	
Special Project: Confluence State Park				
Description Date: 9/6/2006			**Print Date:** 1/2/2007	
Describers Name(s): Keith Knelle, John Horton				
Site Notes:			**Pedon Notes:**	
Sampled Name: WALDRON	**Correlated Name:**		**Certification:** Level 2	
Taxonomic Classification: Fine, smectitic, calcareous, mesic Mollic Fluvaquents				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxadjunct	
SSURGO MU: 66112 - Waldron silty clay, 0 to 2 percent slopes, occasionally flooded			**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association	
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part			**CRA:** M115B.3 - Missouri River Alluvial Plain	
County/SSA: MO183 - ST CHARLES, MO, USA			**7.5' Quad:** 38090-G1 - Wood River, Illinois	
Lat/Long: 38° 49’ 30.5” N, 90° 7’ 19” W			**UTM:** 749,851 E, 4,301,307N -- NAD83 , Zone 15	
Legal: 803 ft West and 2,681 ft North from the South East corner of S9, T47N, R8E of the 5th Principal				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley			**Landform:** flood-plain step	
Geomorphic Component: Tread			**Profile Position:** N/A	
Elevation: 410 ft	**Aspect:** 63°		**Slope:** 0.5%	**Shape:** up/down: Linear - across: Linear
Flooding: occasional; brief			**Ponding:** occasional; brief	
Drainage: Poorly drained	**Runoff:** Negligible	**Permeability:** Very slow	**Ksat:**	**Erosion:** None - deposition
Landcover: Grass/herbaceous cover ; Other grass/herbaceous cover:				
Parent Materials: Slightly weathered, clayey alluvium from mixed materials				
Bedrock: N/A				
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage				
Particle Size Control Section: 10-40" (25-102cm); 52% Clay				

Diagnostic Horizons and Restrictions:
Ochric epipedon: 0 to 9 inches (0-23 cm)
Aquic conditions: 9 to 89 inches (23-226 cm)
Slickensides: 54 to 66 inches (137-168 cm)

SAMPLED AS WABASH **MO318352**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 9 inches (0-23 cm); very dark gray (10YR 3/1, moist, broken face) clay loam; moderate fine and medium subangular blocky structure; slightly effervescent (HCl, 1 normal); firm; common very fine rootsthroughout, and common fine rootsthroughout; common fine interstitial pores; clear smooth boundary.

Cg1 --- 9 to 20 inches (23-51 cm); gray (10YR 5/1, moist, broken face) stratified silty clay loam; massive structure; very slightly effervescent (HCl, 1 normal); very firm; common fine rootsthroughout; common fine interstitial, few fine tubular pores; common very dark gray (10YR 3/1, moist) faint organoargillans on all faces of peds; few yellowish brown (10YR 5/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few dark gray (10YR 4/1, moist) fine faint iron depletions on faces of peds; clear smooth boundary.

Cg2 --- 20 to 35 inches (51-89 cm); dark gray (5Y 4/1, moist, broken face) clay; massive structure; slightly effervescent (HCl, 1 normal); very firm; few very fine rootsthroughout, and few fine rootsthroughout; common very fine tubular, common fine tubular pores; common strong brown (7.5YR 5/8, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, common strong brown (7.5YR 4/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

Cg3 --- 35 to 54 inches (89-137 cm); dark gray (5Y 4/1, moist, broken face) stratified silty clay; massive structure; slightly effervescent (HCl, 1 normal); firm; few very fine rootsthroughout; common very fine tubular, common fine tubular pores; common gray (10YR 6/1, moist) distinct silt coats on all faces of peds; common strong brown (7.5YR 5/8, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few strong brown (7.5YR 4/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

Cg4 --- 54 to 66 inches (137-168 cm); dark gray (2.5Y 4/1, moist, broken face) clay; massive structure; very slightly effervescent (HCl, 1 normal); very firm; few fine tubular pores; few dark gray (2.5Y 4/1, moist) distinct slickensides on all faces of peds; common strong brown (7.5YR 4/6, moist) medium prominent masses of oxidized iron (fe+3) accumulation on faces of peds, common yellowish red (5YR 4/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt smooth boundary.

2Cg5 --- 66 to 76 inches (168-193 cm); 80% gray (10YR 5/1, moist, broken face) , and 20% dark grayish brown (10YR 4/2, moist, broken face) stratified silt loam; massive structure; slightly effervescent (HCl, 1 normal); firm; few fine tubular pores; common strong brown (7.5YR 4/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few gray (2.5Y 5/1, moist) fine faint iron depletions on faces of peds; clear smooth boundary.

2Cg6 --- 76 to 89 inches (193-226 cm); dark gray (2.5Y 4/1, moist, broken face) stratified silty clay loam; massive structure; slightly effervescent (HCl, 1 normal); firm; few fine tubular pores; many dark reddish brown (5YR 3/3, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, common strong brown (7.5YR 4/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few gray (2.5Y 5/1, moist) fine faint iron depletions on faces of peds.

Site ID: Name this Site Here		**Lab ID:** MCL M0618353		
Special Project: Confluence State Park				
Description Date: 9/6/2006		**Print Date:** 1/2/2007		
Describers Name(s): Keith Knelle, John Horton				
Site Notes:		**Pedon Notes:** Rubbing the Ap colors described would make mollic color 10YR 3/2		
Sampled Name: HAYNIE	**Correlated Name:**		**Certification:** Level 2	
Taxonomic Classification: Coarse-silty, mixed, superactive, calcareous, mesic Fluvaquentic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxadjunct	
SSURGO MU: 66009 - Haynie silt loam, 0 to 2 percent slopes, occasionally flooded		**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association		
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part		**CRA:** M115B.3 - Missouri River Alluvial Plain		
County/SSA: MO183 - ST CHARLES, MO, USA		**7.5' Quad:** 38090-G1 - Wood River, Illinois		
Lat/Long: 38° 49’ 37.5” N, 90° 7’ 22.1” W		**UTM:** 749,770 E, 4,301,521N -- NAD83 , Zone 15		
Legal: 1,069 ft West and 3,383 ft North from the South East corner of S9, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley		**Landform:** flood-plain step		
Geomorphic Component: Tread		**Profile Position:** N/A		
Elevation: 410 ft	**Aspect:** 188°	**Slope:** 1%	**Shape:** up/down: Linear - across: Convex	
Flooding: occasional; brief		**Ponding:** none		
Drainage: Somewhat poorly drained	**Runoff:** Low	**Permeability:** Moderately slow	**Ksat:**	**Erosion:** None - deposition
Landcover: Grass/herbaceous cover ; Other grass/herbaceous cover:				
Parent Materials: Slightly weathered, sandy and silty, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				

Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage
Particle Size Control Section: 10-40" (25-102cm); 11% Clay
Diagnostic Horizons and Restrictions: Aquic conditions: 0 to 84 inches (0-213 cm) Mollic epipedon: 0 to 10 inches (0-25 cm) Cambic horizon: 10 to 25 inches (25-64 cm)

SAMPLED AS HAYNIE **MO318353**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 10 inches (0-25 cm); very dark grayish brown (10YR 3/2, moist, rubbed) , 80% very dark gray (10YR 3/1, moist, broken face) , and 20% dark grayish brown (10YR 4/2, moist, broken face) silty clay loam; weak fine subangular blocky structure; very slightly effervescent (HCl, 1 normal); friable; common very fine roots throughout, and common fine roots throughout; common fine interstitial pores; few strong brown (7.5YR 4/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

Bg1 --- 10 to 25 inches (25-64 cm); 90% grayish brown (2.5Y 5/2, moist, broken face) , and 10% dark gray (2.5Y 4/1, moist, broken face) silt loam; weak fine subangular blocky structure; slightly effervescent (HCl, 1 normal); friable; common very fine roots throughout, and common fine roots throughout; common very fine tubular, common fine tubular pores; few yellowish brown (10YR 5/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

Cg1 --- 25 to 34 inches (64-86 cm); 50% light brownish gray (2.5Y 6/2, moist, broken face) , and 50% gray (2.5Y 5/1, moist, broken face) stratified silt loam; massive structure; slightly effervescent (HCl, 1 normal); friable; few very fine roots throughout, and few fine roots throughout; few fine tubular pores; few brownish yellow (10YR 6/8, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; gradual smooth boundary.

Cg2 --- 34 to 48 inches (86-122 cm); grayish brown (2.5Y 5/2, moist, broken face) silt loam; massive structure; slightly effervescent (HCl, 1 normal); friable; few fine roots throughout; few fine tubular, few fine interstitial pores; few gray (2.5Y 5/1, moist) fine faint iron depletions, few yellowish brown (10YR 5/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

Cg3 --- 48 to 60 inches (122-152 cm); 50% grayish brown (2.5Y 5/2, moist, broken face) , and 50% gray (2.5Y 5/1, moist, broken face) stratified very fine sandy loam; massive structure; very slightly effervescent (HCl, 1 normal); very friable; few very fine roots throughout; few fine tubular, few fine interstitial pores; few yellowish brown (10YR 5/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

Cg4 --- 60 to 84 inches (152-213 cm); 50% grayish brown (2.5Y 5/2, moist, broken face) , and 50% gray (2.5Y 5/1, moist, broken face) stratified silt; massive structure; slightly effervescent (HCl, 1 normal); friable; common fine tubular pores; common gray (2.5Y 6/1, moist) fine faint iron depletions on faces of peds, common strong brown (7.5YR 5/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; Note(s): Free water identified at 66 inches.

Site ID: Name this Site Here		**Lab ID:** MCL M0618354		
Special Project: Confluence State Park				
Description Date: 9/6/2006		**Print Date:** 1/2/2007		
Describers Name(s): John Horton, Keith Knelle, Dennis Meinert				
Site Notes:		**Pedon Notes:** Mixing colors described in the "A" horizon would result in mollic color 10YR 3/2		
Sampled Name: HAYNIE	**Correlated Name:**		**Certification:** Level 2	
Taxonomic Classification: Coarse-silty, mixed, superactive, nonacid, mesic Fluvaquentic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxadjunct	
SSURGO MU: 66009 - Haynie silt loam, 0 to 2 percent slopes, occasionally flooded		**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association		
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part		**CRA:** M115B.3 - Missouri River Alluvial Plain		
County/SSA: MO183 - ST CHARLES, MO, USA		**7.5' Quad:** 38090-G2 - Columbia Bottom, Missouri		
Lat/Long: 38° 49' 44.8" N, 90° 7' 32.6" W		**UTM:** 749,508 E, 4,301,738N -- NAD83 , Zone 15		
Legal: 1,129 ft East and 2,755 ft South from the North West corner of S9, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley		**Landform:** flood-plain step		
Geomorphic Component: Tread		**Profile Position:** N/A		
Elevation: 412 ft	**Aspect:** 171°	**Slope:** 0.5%	**Shape:** up/down: Linear - across: Linear	
Flooding: occasional; brief		**Ponding:** none		
Drainage: Somewhat poorly drained	**Runoff:** Negligible	**Permeability:** Moderately slow	**Ksat:**	**Erosion:** None - deposition
Landcover: Grass/herbaceous cover ; Other grass/herbaceous cover				
Parent Materials: Slightly weathered, silty, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				

Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage
Particle Size Control Section: 10-40" (25-102cm); 16% Clay
Particle Size Control Section: 10-40" (25-102cm); 16% Clay Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 14 inches (0-36 cm) Aquic conditions: 14 to 80 inches (36-203 cm)

SAMPLED AS PARKVILLE MO318354

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 5 inches (0-13 cm); very dark gray (10YR 3/1, moist, broken face) silt loam; weak fine subangular blocky structure; friable; common very fine roots throughout, and common fine roots throughout; common fine interstitial pores; abrupt smooth boundary.

A --- 5 to 14 inches (13-36 cm); very dark grayish brown (10YR 3/2, moist, rubbed) , 90% very dark gray (10YR 3/1, moist, broken face) , and 10% dark grayish brown (10YR 4/2, moist, broken face) silt loam; weak fine subangular blocky structure; friable; common very fine roots throughout, and common fine roots throughout; common fine tubular, few fine interstitial pores; clear smooth boundary.

Cg1 --- 14 to 19 inches (36-48 cm); 60% dark grayish brown (10YR 4/2, moist, broken face) , and 40% dark gray (10YR 4/1, moist, broken face) stratified silt loam; massive structure; slightly effervescent (HCl, 1 normal); firm; few very fine roots throughout, and few fine roots throughout; few fine tubular, few medium tubular pores; few strong brown (7.5YR 5/6, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries; abrupt smooth boundary.

Cg2 --- 19 to 27 inches (48-69 cm); 70% dark grayish brown (2.5Y 4/2, moist, broken face) , and 30% dark gray (5Y 4/1, moist, broken face) silt loam; massive structure; slightly effervescent (HCl, 1 normal); friable; few fine roots throughout; few fine tubular pores; common strong brown (7.5YR 5/6, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, few brown (7.5YR 4/4, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, common gray (10YR 5/1, moist) fine prominent noncemented irregular iron depletions throughout with sharp boundaries; clear smooth boundary.

2Cg3 --- 27 to 44 inches (69-112 cm); 50% grayish brown (2.5Y 5/2, moist, broken face) , and 50% dark gray (2.5Y 4/1, moist, broken face) silt loam; massive structure; slightly effervescent (HCl, 1 normal); friable; few fine roots throughout; few fine tubular pores; common strong brown (7.5YR 5/6, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, common strong brown (7.5YR 4/6, moist) fine

prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, few dark brown (7.5YR 3/4, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries; clear smooth boundary.

2Cg4 --- 44 to 57 inches (112-145 cm); dark gray (5Y 4/1, moist, broken face) silt loam; massive structure; slightly effervescent (HCl, 1 normal); friable; few very fine roots throughout; few fine tubular, few fine interstitial pores; common strong brown (7.5YR 4/6, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, few dark brown (7.5YR 3/4, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, few gray (10YR 5/1, moist) fine distinct noncemented irregular iron depletions throughout with sharp boundaries; gradual smooth boundary.

2Cg5 --- 57 to 74 inches (145-188 cm); dark gray (5Y 4/1, moist, broken face) silt loam; massive structure; slightly effervescent (HCl, 1 normal); friable; few fine tubular pores; few light gray (10YR 7/2, moist) distinct sand coats on surfaces along pores; common strong brown (7.5YR 4/6, moist) medium prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, common strong brown (7.5YR 4/6, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, few gray (10YR 5/1, moist) fine distinct noncemented irregular iron depletions throughout with sharp boundaries, common dark brown (7.5YR 3/4, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries; Note(s): Free water observed at 64 inches/163 cm; clear smooth boundary.

3Cg6 --- 74 to 86 inches (188-218 cm); 70% dark gray (5Y 4/1, moist, broken face) , and 30% dark grayish brown (2.5Y 4/2, moist, broken face) silty clay loam; massive structure; slightly effervescent (HCl, 1 normal); friable; few very fine tubular pores; few brown (10YR 5/3, moist) faint sand coats on surfaces along pores; common dark brown (7.5YR 3/4, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, common dark brown (7.5YR 3/4, moist) medium prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, few strong brown (7.5YR 4/6, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries.

Site ID: Name this Site Here			**Lab ID:** MCL M0618355	
Special Project: Confluence State Park				
Description Date: 9/6/2006			**Print Date:** 1/2/2007	
Describers Name(s): John Horton, Keith Knelle, Dennis Meinert				
Site Notes:			**Pedon Notes:**	
Sampled Name: WALDRON	**Correlated Name:**		**Certification:** Level 2	
Taxonomic Classification: Fine, smectitic, mesic Fluvaquentic Vertic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxadjunct	
SSURGO MU: 66112 - Waldron silty clay, 0 to 2 percent slopes, occasionally flooded			**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association	
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part			**CRA:** M115B.3 - Missouri River Alluvial Plain	
County/SSA: MO183 - ST CHARLES, MO, USA			**7.5' Quad:** 38090-G1 - Wood River, Illinois	
Lat/Long: 38° 50’ 2.9” N, 90° 7’ 23.9” W			**UTM:** 749,700 E, 4,302,303N -- NAD83 , Zone 15	
Legal: 1,759 ft East and 902 ft South from the North West corner of S9, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley			**Landform:** flood-plain step	
Geomorphic Component: Tread			**Profile Position:** N/A	
Elevation: 412 ft	**Aspect:** 281°		**Slope:** 0.5%	**Shape:** up/down: Linear - across: Linear
Flooding: occasional; brief			**Ponding:** occasional; brief	
Drainage: Poorly drained	**Runoff:** Negligible	**Permeability:** Slow	**Ksat:**	**Erosion:** None - deposition
Landcover: Grass/herbaceous cover ; Other grass/herbaceous cover:				
Parent Materials: Slightly weathered, clayey, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage				
Particle Size Control Section: 10-40" (25-102cm); 48% Clay				

Diagnostic Horizons and Restrictions:
Aquic conditions: 0 to 82 inches (0-208 cm)
Mollic epipedon: 0 to 20 inches (0-51 cm)
Cambic horizon: 20 to 28 inches (51-71 cm)

SAMPLED AS AHOLT MO318355

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 6 inches (0-15 cm); very dark gray (10YR 3/1, moist, broken face) silty clay; moderate fine subangular blocky structure; slightly effervescent (HCl, 1 normal); firm; common very fine rootsthroughout, and common fine rootsthroughout; few fine tubular, common fine interstitial pores; abrupt smooth boundary.

A --- 6 to 20 inches (15-51 cm); very dark gray (10YR 3/1, moist, broken face) silty clay; moderate medium prismatic parting to strong fine subangular blocky structure; very firm; common very fine rootsthroughout, and common fine rootsthroughout; common fine tubular pores; very few very dark gray (10YR 3/1, moist) faint slickensides on all faces of peds; few strong brown (7.5YR 5/6, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, few gray (10YR 5/1, moist) fine faint noncemented irregular iron depletions throughout with sharp boundaries; clear smooth boundary.

Bg --- 20 to 28 inches (51-71 cm); dark gray (2.5Y 4/1, moist, broken face) silty clay; moderate medium prismatic parting to strong fine subangular blocky structure; very firm; common very fine rootsthroughout, and common fine rootsthroughout; few fine tubular, few fine interstitial pores; common brown (7.5YR 4/4, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, few gray (2.5Y 5/1, moist) fine faint noncemented irregular iron depletions throughout with sharp boundaries; clear smooth boundary.

Cg1 --- 28 to 46 inches (71-117 cm); 60% gray (5Y 5/1, moist, broken face) , and 40% olive gray (5Y 4/2, moist, broken face) stratified silty clay; massive structure; slightly effervescent (HCl, 1 normal); very firm; few very fine rootsthroughout, and common fine rootsthroughout; few very fine tubular, few fine tubular pores; common dark brown (7.5YR 3/4, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, common gray (5Y 5/1, moist) fine faint noncemented irregular iron depletions throughout with sharp boundaries; clear smooth boundary.

Cg2 --- 46 to 70 inches (117-178 cm); 60% gray (5Y 5/1, moist, broken face) , and 40% olive gray (5Y 4/2, moist, broken face) stratified silty clay loam; massive structure; slightly effervescent (HCl, 1 normal); firm; few fine rootsthroughout; few fine pores; common dark

reddish brown (2.5YR 3/4, moist) medium prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, few strong brown (7.5YR 5/6, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries; Note(s): Keith Knelle , Note(s): Very fine sand lining outside of prisms and in pockets; gradual smooth boundary.

Cg3 --- 70 to 84 inches (178-213 cm); 60% gray (5Y 5/1, moist, broken face) , and 40% olive gray (5Y 4/2, moist, broken face) stratified silty clay loam; massive structure; slightly effervescent (HCl, 1 normal); firm; few strong brown (7.5YR 5/6, moist) fine prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries, common dark reddish brown (2.5YR 3/4, moist) medium prominent noncemented irregular masses of oxidized iron (fe+3) accumulation throughout with sharp boundaries.

Site ID: Name this Site Here			**Lab ID:** MCL M0618356	
Special Project: Confluence State Park				
Description Date: 9/6/2006			**Print Date:** 1/2/2007	
Describers Name(s): Keith Knelle, John Horton, Teresa Gerber				
Site Notes:			**Pedon Notes:**	
Sampled Name: WALDRON	**Correlated Name:**		**Certification:** Level 2	
Taxonomic Classification: Clayey over loamy, smectitic, nonacid, mesic Cumulic Vertic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxadjunct	
			General Soil MU: MO065 - Haynie-Blake-Leta-Waldron Association	
			CRA: M115B.3 - Missouri River Alluvial Plain	
			7.5' Quad: 38090-G2 - Columbia Bottom, Missouri	
Lat/Long: 38° 49' 57.4" N, 90° 8' 4.5" W			**UTM:** 748,727 E, 4,302,104N -- NAD83 , Zone 15	
Legal: 1,433 ft West and 1,555 ft South from the North East corner of S8, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley			**Landform:** flood-plain step	
Geomorphic Component: Tread			**Profile Position:** N/A	
Elevation: 416 ft	**Aspect:** 115°		**Slope:** 1%	**Shape:** up/down: Concave - across: Linear
Flooding: occasional; brief			**Ponding:** none	
Drainage: Somewhat poorly drained	**Runoff:** Very low	**Permeability:** Slow	**Ksat:**	**Erosion:** None - deposition
Landcover: Grass/herbaceous cover ; Other grass/herbaceous cover:				
Parent Materials: Slightly weathered, clayey, Holocene Stage alluvium from mixed materials over slightly weathered, sandy and silty, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				

Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage
Particle Size Control Section: 10-40" (25-102cm); 38% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 31 inches (0-79 cm) Aquic conditions: 9 to 83 inches (23-211 cm); Cambic horizon: 9 to 31 inches (23-79 cm)

SAMPLED AS LEVASY **MO318305**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 9 inches (0-23 cm); very dark gray (10YR 3/1, moist, interior) silty clay loam; moderate fine and medium subangular blocky structure; firm; common fine roots throughout, and common medium roots throughout; common fine interstitial pores; clear smooth boundary.

Bg --- 9 to 31 inches (23-79 cm); very dark gray (10YR 3/1, moist, interior) silty clay; moderate medium prismatic parting to strong fine subangular blocky structure; very firm; few fine roots throughout, and few medium roots throughout; common fine tubular pores; few dark yellowish brown (10YR 4/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt smooth boundary.

2C --- 31 to 55 inches (79-140 cm); brown (10YR 4/3, moist, interior) stratified loam; massive structure; slightly effervescent (HCl, 1 normal); friable; few very fine roots throughout, and few fine roots throughout; few fine interstitial pores; few strong brown (7.5YR 4/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few gray (10YR 5/1, moist) fine distinct iron depletions throughout; Note(s): stratified, dominant aquic conditions; clear smooth boundary.

2Cg1 --- 55 to 63 inches (140-160 cm); dark gray (10YR 4/1, moist, interior) silt loam; massive structure; slightly effervescent (HCl, 1 normal); friable; few very fine roots throughout; few fine interstitial pores; few strong brown (7.5YR 5/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few red (2.5YR 5/6, moist) medium prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few gray (2.5Y 5/1, moist) fine faint iron depletions throughout; gradual smooth boundary.

2Cg2 --- 63 to 68 inches (160-173 cm); dark gray (5Y 4/1, moist, interior) silty clay loam; massive structure; slightly effervescent (HCl, 1 normal); firm; few fine tubular pores; few strong brown (7.5YR 4/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

2Cg3 --- 68 to 83 inches (173-211 cm); dark grayish brown (2.5Y 4/2, moist, interior) silt loam; massive structure; slightly effervescent (HCl, 1 normal); very friable; few fine interstitial pores;

common brown (7.5YR 4/4, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds.

Site ID: Name this Site Here			**Lab ID:** MCL M0618357	
Special Project: Confluence State Park				
Description Date: 9/6/2006			**Print Date:** 1/2/2007	
Describers Name(s): Keith Knelle, John Horton				
Site Notes:			**Pedon Notes:**	
Sampled Name: WALDRON	**Correlated Name:**		**Certification:** Level 2	
Taxonomic Classification: Clayey over loamy, smectitic, nonacid, mesic Cumulic Vertic Epiaquolls				
Pedon Type: map unit inclusion	**Pedon Purpose:** full pedon description		**Taxon Kind:** Taxadjunct	
SSURGO MU: 66112 - Waldron silty clay, 0 to 2 percent slopes, occasionally flooded			**General Soil MU:** MO065 - Haynie-Blake-Leta-Waldron Association	
MLRA: M115B - Central Mississippi Valley Wooded Slopes, Western Part			**CRA:** M115B.3 - Missouri River Alluvial Plain	
County/SSA: MO183 - ST CHARLES, MO, USA			**7.5' Quad:** 38090-G2 - Columbia Bottom, Missouri	
Lat/Long: 38° 50' 19.3" N, 90° 7' 45.6" W			**UTM:** 749,163 E, 4,302,792N -- NAD83 , Zone 15	
Legal: 3 ft West and 703 ft North from the South East corner of S5, T47N, R8E of the 5th Principal Meridian				
US Phys Div: Interior Highlands	**US Phys Prov:** Ozark Plateau		**US Phys Sec:** Springfield-Salem plateaus	
MO Eco Sec: OZ - Ozark Highlands	**MO Eco Subsec:** OZ15 - Missouri River Alluvial Plain		**MO LTA:** OZ15c - West Alton Alluvial Plain	
Landscape: river valley			**Landform:** flood-plain step	
Geomorphic Component: Tread			**Profile Position:** N/A	
Elevation: 410 ft	**Aspect:** 240°		**Slope:** 0.5%	**Shape:** up/down: Linear - across: Convex
Flooding: occasional; brief			**Ponding:** none	
Drainage: Somewhat poorly drained	**Runoff:** Very low	**Permeability:** Slow	**Ksat:**	**Erosion:** None - deposition
Landcover: Grass/herbaceous cover ; Other grass/herbaceous cover:				
Parent Materials: Slightly weathered, clayey, Holocene Stage alluvium from mixed materials over slightly weathered, silty, Holocene Stage alluvium from mixed materials				
Bedrock: N/A				
Geologic Formation: Cenozoic Era, Quaternary System, Holocene Stage				

Particle Size Control Section: 10-40" (25-102cm); 40% Clay
Diagnostic Horizons and Restrictions: Mollic epipedon: 0 to 30 inches (0-76 cm) Aquic conditions: 6 to 82 inches (15-208 cm) Abrupt textural change: 30 inches (76 cm) (Restrictive layer)

SAMPLED AS LEVASY **MO318305**

Horizon Description **Observation method:** Push Tube

Ap --- 0 to 6 inches (0-15 cm); very dark gray (10YR 3/1, moist, interior) silty clay; moderate fine subangular blocky structure; firm; common very fine roots throughout, and common fine roots throughout; common fine interstitial pores; clear smooth boundary.

A1 --- 6 to 21 inches (15-53 cm); very dark gray (10YR 3/1, moist, interior) silty clay; moderate fine prismatic parting to moderate fine subangular blocky structure; very firm; common very fine roots throughout, and common fine roots throughout; common fine tubular pores; few strong brown (7.5YR 4/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; abrupt smooth boundary.

A2 --- 21 to 30 inches (53-76 cm); very dark grayish brown (10YR 3/2, moist, rubbed) , 80% very dark gray (10YR 3/1, moist, interior) , and 20% dark grayish brown (10YR 4/2, moist, interior) silty clay; moderate fine subangular blocky structure; very friable; common very fine roots throughout, and common fine roots throughout; common fine tubular pores; few strong brown (7.5YR 4/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds; clear smooth boundary.

2Cg1 --- 30 to 44 inches (76-112 cm); 70% dark grayish brown (10YR 4/2, moist, interior) , and 30% dark gray (10YR 4/1, moist, interior) stratified silt loam; massive structure; slightly effervescent (HCl, 1 normal); friable; few very fine roots throughout, and few fine roots throughout; few fine tubular pores; common strong brown (7.5YR 4/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few strong brown (7.5YR 5/6, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few gray (2.5Y 5/1, moist) fine faint iron depletions throughout; gradual smooth boundary. Note(s): stratified, dominant, aquic conditions from this horizon down.

2Cg2 --- 44 to 64 inches (112-163 cm); 50% dark gray (10YR 4/1, moist, interior) , and 50% dark grayish brown (10YR 4/2, moist, interior) stratified silt loam; massive structure; slightly effervescent (HCl, 1 normal); firm; few very fine roots throughout; few fine tubular pores; few brown (7.5YR 4/4, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few gray (2.5Y 5/1, moist) fine faint iron depletions throughout; clear smooth boundary. Note(s): stratified.

2Cg3 --- 64 to 82 inches (163-208 cm); 60% dark grayish brown (2.5Y 4/2, moist, interior) , and 40% dark gray (2.5Y 4/1, moist, interior) stratified silt loam; massive structure; slightly effervescent (HCl, 1 normal); very friable; few very fine roots throughout; few fine tubular pores; few brown (7.5YR 4/4, moist) fine prominent masses of oxidized iron (fe+3) accumulation on faces of peds, few gray (10YR 5/1, moist) fine faint iron depletions throughout; Note(s): stratified.

APPENDIX F

Soil Classification for mapped series

1 -- Haynie: Coarse-silty, mixed, superactive, calcareous, mesic Mollic Udifluvent

2 -- Parkville, Coarse-loamy, mixed, superactive, mesic Aquertic Hapludoll

3 -- Leta: Clayey over loamy, smectitic over mixed, mesic Aquertic Hapludoll

3 -- Levasy: Clayey over loamy, smectitic over mixed, mesic Fluvaquentic Vertic Epiaquoll

4 -- Tieville: Fine, smectitic, mesic Fluvaquentic Vertic Epiaquoll

4 -- Lakeport: Fine, smectitic, mesic Aquertic Hapludoll

5 -- Wabash, Fine, smectitic, mesic Cumulic Vertic Epiaquoll

6 -- Aholt, Very-fine, smectitic, calcareous, mesic Cumulic Vertic Epiaquoll

7 -- Blake, Fine-silty, smectitic, calcareous, mesic Fluvaquentic Hapludoll

APPENDIX G

AHOLT SERIES

The Aholt series consists of very poorly drained, very slowly permeable soils that formed in thick clayey calcareous alluvium or clayey lacustrine sediments. These soils are on nearly level or slightly depressional low benches and first bottom lands along major rivers and their tributaries and on high benches and glacial lake plains. Mean annual temperature is 54 degrees F, and mean annual precipitation is 37 inches.

TAXONOMIC CLASS: Very-fine, smectitic, calcareous, mesic Vertic Endoaquolls

TYPICAL PEDON: Aholt clay - on a nearly level area in an idle field. (Colors are for moist soil unless otherwise stated).

Ap--0 to 6 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; strong fine and very fine granular structure; very sticky, very hard; many fine roots; slight effervescence; neutral; clear smooth boundary. (4 to 10 inches thick)

Bg1--6 to 14 inches; black (10YR 2/1) clay, dark gray (N 4/0) dry; few fine distinct brown (10YR 4/3) mottles; strong very fine angular and subangular blocky structure; very sticky, very hard; common fine roots; shiny pressure faces; slight effervescence, mildly alkaline; smooth gradual boundary.

Bg2--14 to 22 inches; very dark gray (10YR 3/1) clay, dark gray (N 4/0) dry; few fine distinct dark grayish brown (2.5Y 4/2) and brown (10YR 4/3) mottles; moderate medium angular and subangular blocky structure; very sticky, very hard; few fine roots; few very fine calcium carbonate concretions; shiny pressure faces; strong effervescence; mildly alkaline; gradual smooth boundary.

Bg3--22 to 34 inches; gray (5Y 5/1) clay, common fine distinct dark grayish brown (2.5Y 4/2) and common fine prominent olive brown (2.5Y 4/4) mottles; moderate medium angular and subangular blocky structure; very sticky, very hard; few fine calcium carbonate concretions; shiny pressure faces; strong effervescence; mildly alkaline; gradual smooth boundary.

Bg4--34 to 46 inches; mixed gray (5Y 5/1) and dark gray (5Y 4/1) clay; common fine prominent olive brown (2.5Y 4/4) mottles; weak coarse subangular blocky structure; very sticky, very hard; few fine calcium carbonate concretions; shiny pressure faces; strong effervescence; mildly alkaline; clear smooth boundary. (Combined thickness of the Bg horizon is 34 to more than 70 inches.)

Cg1--46 to 58 inches; gray (5Y 5/1) and (5Y 6/1) silty clay loam; common medium prominent light olive brown (2.5Y 5/4) mottles; massive; sticky, hard; strong effervescence; mildly alkaline; gradual smooth boundary. Cg2--58 to 66 inches; mottled gray (10YR 5/1) and yellowish brown (10YR 5/6) silty clay loam; massive; sticky, hard; strong effervescence; mildly alkaline.

TYPE LOCATION: Ray County, Missouri; about 2-1/8 miles east of Hardin; 1,980 feet south and 660 feet east of the northwest corner of sec. 35, T. 52 N., R. 26 W.

RANGE IN CHARACTERISTICS: The mollic epipedon is 10 to 24 inches thick. Free carbonates are throughout the control section and reaction ranges from neutral to moderately alkaline.

The Ap horizon has hue of 10YR or 2.5Y; value of 2 or 3, 3 through 5 dry; and chroma of 1 or 2. It is clay or silty clay.

The Bg horizon is neutral or has hue of 2.5Y or 5Y; value of 2 to 6, and chroma of 0 to 2; the darker colors are in the upper part. Some pedons are mottled gray and brown in the lower part. It is clay or silty clay and the control section averages more than 60 percent clay. Distinct or prominent brown and gray mottles occur throughout the soil below the Ap horizons.

The Cg horizon has hue of 2.5Y or 5Y, or is neutral; value of 2 to 6; and chroma of 0 or 2. It is silty clay or silty clay loam and may include thin strata of coarser textures.
COMPETING SERIES: These are the Bosworth, Kolls, and Ryepatch series in the same family and the Booker, Carlow, Darwin, Wabash, and Waldron series. Bosworth soils are stratified with thin coarser strata and also lack secondary calcium carbonate concretions. Kolls and Ryepatch soils are in areas of lower rainfall. Booker soils lack free carbonates. Carlow, Darwin, and Wabash soils contain less clay and lack free carbonates. Waldron soils contain less clay and generally are stratified below the surface layer.
GEOGRAPHIC SETTING: Aholt soils are on nearly level or slightly depressional low benches and first bottom lands along major rivers and on high benches and glacial lake plains. The slope gradient is 0 to 2 percent. These soils formed in thick clayey calcareous alluvium or clayey lacustrine sediments. The mean annual temperature varies from 52 to 57 degrees F, and mean annual precipitation varies from 32 to 42 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Booker, Tina, Wabash, and Zook soils. Booker soils lack free carbonates and occur on similar landscapes. Tina soils contain less clay and occur on higher bottom positions. Wabash and Zook soils contain less clay and occur on similar landscapes.

DRAINAGE AND PERMEABILITY: Very poorly drained. Permeability is very slow. Runoff is very slow.

USE AND VEGETATION: Soils are cropped to corn, soybeans, and wheat. Native vegetation was willow, cottonwood, and marsh grasses.

DISTRIBUTION AND EXTENT: Missouri and Illinois. Aholt soils are of small extent.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Clay and Ray Counties, Missouri, 1982.

REMARKS: Diagnostic horizons and features recognized in this series are:
Mollic epipedon-the zone from the surface of the soil to a depth of 22 inches (Ap, Bg1, and Bg2 horizons); Cambic horizon-the zone from approximately 22 inches to 46 inches (Bg3 and Bg4 horizons).

BLAKE SERIES

The Blake series consists of very deep, somewhat poorly drained soils on flood plains. These soils formed in recently deposited calcareous, silty alluvium. Permeability is moderate in the upper part and moderate or moderately rapid in the lower part. Slopes range from 0 to 2 percent. Mean annual air temperature is about 51 degrees F. Mean annual precipitation is about 28 inches.

TAXONOMIC CLASS: Fine-silty, mixed, superactive, calcareous, mesic Aquic Udifluvents

TYPICAL PEDON: Blake silty clay loam, on a nearly level, southwest-facing slope in a cultivated field, at an elevation of 1,007 feet above sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 7 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silty clay loam, very dark gray (10YR 3/1) crushed, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; friable; few fine pores; few dark stains around root channels; slightly effervescent; slightly alkaline; clear smooth boundary. (6 to 10 inches thick)

Cg1--7 to 24 inches; dark grayish brown (10YR 4/2) and dark gray (10YR 4/1) silty clay loam, olive brown (2.5Y 4/4) kneaded, light brownish gray (10YR 6/2) dry; massive with weak thin alluvial stratification; few fine dark accumulations (oxides); few fine distinct dark yellowish brown (10YR 4/4) masses of iron; few fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; slightly effervescent; slightly alkaline; clear smooth boundary. (12 to 50 inches thick)

Cg2--24 to 60 inches; grayish brown (2.5Y 5/2) silt loam; massive with weak thin alluvial stratification; very friable; common very fine pores; some streaks of pale brown (10YR 6/3) calcium carbonate concentrations; few fine distinct dark gray (10YR 4/1) redoximorphic depletions; strongly effervescent; slightly alkaline.

TYPE LOCATION: Harrison County, Iowa; about 6 miles west of Missouri Valley; about 1,950 feet east and 140 feet south of the northwest corner of sec. 16, T. 78 N., R. 45 W.; USGS Modale quadrangle; lat. 41 degrees 33 minutes 35 seconds N. and long. 96 degrees 1 minute 35 seconds W., NAD 83

RANGE IN CHARACTERISTICS:
Depth to carbonates--0 to 10 inches
Content of clay in the particle-size control section (weighted average)--22 to 35 percent
Content of sand in the particle-size control section (weighted average)--less than 15 percent fine sand and sand coarser than fine sand

Ap or A horizon:
Hue--10YR or 2.5Y
Value--3 or 4
Chroma--1 or 2
Texture--silty clay loam, silt loam, or loam
Clay content--18 to 38 percent
Sand content--1 to 40 percent fine sand and sand coarser than fine sand
Reaction--neutral to moderately alkaline

Cg1 horizon:
Hue--10YR or 2.5Y
Value--3 or 4
Chroma--1 to 4
Texture--silt loam or silty clay loam but individual strata range in texture from very fine sandy loam to silty clay
Clay content--22 to 35 percent

Sand content--less than 15 percent fine sand and sand coarser than fine sand
Reaction--slightly alkaline or moderately alkaline
Some pedons have strata that do not have redoximorphic features
Cg2 horizon:
Hue--10YR or 2.5Y
Value--2 to 5
Chroma--1 to 3
Texture--silt loam or silty clay loam
Clay content--10 to 30 percent
Sand content--less than 15 percent fine sand and sand coarser than fine sand
Reaction--slightly alkaline or moderately alkaline
Some pedons have strata between depths of 40 to 60 inches of loamy very fine sand, loam, very fine sandy loam or silty clay up to 12 inches thick
Some pedons have very thin darkened layers
Some pedons have a sandy substratum below a depth of 60 inches

COMPETING SERIES: This is the Lossing series.
Losing--have a sand content of 15 to 50 percent in the lower two thirds of the series control section

GEOGRAPHIC SETTING:
Parent material--recently deposited calcareous, silty alluvium
Landform--flood plains
Slopes--0 to 2 percent
Elevation--700 to 1,650 feet above sea level
Mean annual air temperature--47 to 56 degrees F.
Mean annual precipitation--20 to 36 inches
Frost-free period--135 to 165 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Albaton, Grable, Haynie and Onawa soils.
Albaton--are in the slightly lower landscape positions and have a saturated zone within a depth of 1 foot during April to June in most years
Grable--are in landscape positions similar to those of the Blake soils, do not have a saturated zone within a depth of 6 feet during April to June in most years and have a sand content of 65 to 95 percent in the lower two thirds of the particle-size control section
Haynie--are at the higher elevations, do not have a saturated zone within a depth of 6 feet during April to June in most years and have a sand content of less than 15 percent in the particle-size control section
Onawa--are in landscape positions similar to those of the Blake soils and have a clay content of 10 to 18 percent in the lower two thirds of the particle-size control section

DRAINAGE AND PERMEABILITY:
Drainage class--somewhat poorly drained--a saturated zone occurs within depths of 1 to 3 feet during April to June in most years, is considered apparent and the depth to saturation has been influenced by the down-cutting of nearby streams

Permeability--moderate in the upper part and moderate or moderately rapid in the lower part
Surface runoff potential--low
Flooding--rare or occasional flooding for brief periods during the months of February to November resulting from precipitation events and snowmelt and flooding from streambank overflow is limited where dams and levees protect areas

USE AND VEGETATION:
Most areas are cultivated. The principal crops are corn, oats, and soybeans. Some areas are leveled and irrigated. The native vegetation is big bluestem, indiangrass, switchgrass, and other grasses of the tall grass prairie.

DISTRIBUTION AND EXTENT:
LRR M, MLRAs 102B, 107, 115; flood plains of the Missouri River in Iowa, South Dakota, Nebraska and Missouri and flood plains of the Mississippi River in Illinois. This series is of moderate extent.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Woodbury County, Iowa, 1971.

REMARKS:
Particle-size control section--the zone from a depth of 10 to 40 inches (Cg1 and Cg2 horizons);
series control section--the zone from the surface to a depth of 60 inches (Ap, Cg1 and Cg2 horizons).
Diagnostic horizons and features recognized in this pedon:
Ochric epipedon--the zone from the surface to a depth of 7 inches (Ap horizon); udic moisture regime.
Cation-exchange class is inferred from lab data for similar soils in the surrounding area.
Taxonomy version--Second Edition, 1999.
Blake soils were correlated as Onawa silty clay loam in previous soil surveys.

ADDITIONAL DATA:
Laboratory data--Iowa State University, Ames, Iowa.
National Cooperative Soil Survey
U.S.A.

HAYNIE SERIES

The Haynie series consists of very deep, moderately well drained soils on flood plains. These soils formed in calcareous alluvium. Slopes range from 0 to 5 percent. Mean annual air temperature is about 51 degrees F. Mean annual precipitation is about 28 inches.

TAXONOMIC CLASS: Coarse-silty, mixed, superactive, calcareous, mesic Mollic Udifluvents

TYPICAL PEDON: Haynie silt loam, on a nearly level slope, in a cultivated field, at an elevation of 1,065 feet above sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (2.5Y 5/2) dry; small clods parting to weak fine subangular blocky and weak fine granular structure; some stratification of lighter colors in the lower part; very friable; few dark brown (10YR 3/3) organic stains on faces of peds; slightly effervescent; slightly alkaline; clear smooth boundary. (6 to 9 inches thick)

C--7 to 60 inches; alternating layers of dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silt loam, light brownish gray (2.5Y 6/2) dry; massive with weak thin alluvial stratification; common 1/4 to 1/8 inch lenses of very fine sandy loam; a lens of very fine sandy loam at 10 to 13 inches; very friable; common fine distinct gray (5Y 5/1) redoximorphic depletions; few fine distinct dark yellowish brown (10YR 4/4) and few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; not all strata have redoximorphic features; strongly effervescent; slightly alkaline.

TYPE LOCATION: Monona County, Iowa; about 1 1/2 miles west and 1 mile north of Whiting; about 790 feet west and 1,420 feet north of the center of sec. 34, T. 85 N., R. 46 W.; USGS Sloan quadrangle; lat. 42 degrees 8 minutes 20 seconds N. and long. 96 degrees 11 minutes 15 seconds W., NAD 27.

RANGE IN CHARACTERISTICS:
Depth to carbonates--0 to 10 inches
Depth to redoximorphic concentrations--6 to 10 inches
Thickness of the ochric epipedon--less than 10 inches
Content of clay in the particle-size control section (weighted average)--15 to 18 percent
Content of sand in the particle-size control section (weighted average)--18 to 80 percent, mostly very fine sand, less than 15 percent fine sand and sand coarser than fine sand

Ap horizon:
Hue--10YR or 2.5Y
Value--3
Chroma--2
Texture--silt loam, very fine sandy loam, or silty clay loam
Clay content--15 to 30 percent
Sand content--18 to 55 percent

Calcium carbonate equivalent--0 to 25 percent
Reaction--neutral or slightly alkaline

C horizon:
Hue--10YR or 2.5Y
Value--4 or 5
Chroma--2 to 4
Texture: silt loam or very fine sandy loam, but some pedons contain strata, less than 5 inches thick, of fine sandy loam and loamy fine sand
Clay content--15 to 18 percent
Sand content--18 to 80 percent, mostly very fine sand
Calcium carbonate equivalent--3 to 30 percent
Reaction--slightly alkaline or moderately alkaline
The redoximorphic features in this profile are believed to be relict features
Some pedons have silty clay loam and silty clay strata below a depth of 50 inches
Some pedons have sandy materials below a depth of 60 inches
Some pedons have thin silty clay layers below a depth of 40 inches

COMPETING SERIES: These are the Ion and McPaul series.
Ion--have a buried soil within a depth of 20 to 40 inches
McPaul--do not have a hue of 2.5Y in the series control section

GEOGRAPHIC SETTING:
Parent material--calcareous alluvium
Landform--flood plains
Slopes--0 to 5 percent
Elevation--700 to 1,650 feet above sea level
Mean annual air temperature--47 to 56 degrees F.
Mean annual precipitation--20 to 36 inches
Frost-free period--135 to 190 days
Note: The alluvium is 3 to many feet thick and typically grades to sandy alluvium as depth increases.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Albaton, Grable, Modale, Onawa, and Sarpy soils.
Albaton--are in the lower elevations and have a clay content of more than 50 percent in the particle-size control section
Grable--are in landscape positions similar to those of the Haynie soils and have 65 to 95 percent fine sand within a depth of 18 to 30 inches
Modale--are in landscape positions similar to those of the Haynie soils and have a clay content of 40 to 60 percent within a depth of 18 to 30 inches
Onawa--are in the lower elevations and have a clay content of 50 to 60 percent in the upper third of the particle-size control section
Sarpy--are at the higher elevations and have a clay content of 2 to 5 percent in the particle-size control section

DRAINAGE AND PERMEABILITY:
Drainage class--moderately well drained--a saturated zone occurs within depths of 4 to 6 feet during April to June in most years and is considered apparent
Permeability--moderate
Surface runoff potential--low
Flooding--none to frequent for brief to long periods during the months of February to November in most years resulting from precipitation events and snowmelt

USE AND VEGETATION:
Most areas are cultivated. The principal crops are corn, soybeans, small grain, and hay. Some areas are land-leveled and irrigated. The native vegetation is big bluestem, indiangrass, switchgrass, and other grasses of the tall grass prairie.

DISTRIBUTION AND EXTENT:
LRR G, MLRA 63B; LRR H, MLRA 76; LRR M, MLRAs 102B, 106, 107, 115; western Iowa, eastern Kansas, Nebraska, South Dakota, western Illinois, and Missouri. This series is of large extent.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Clay County, South Dakota, 1953.

REMARKS:
Particle-size control section--the zone from a depth of 10 to 40 inches (C horizon);
Series control section--the zone from the surface to a depth of 60 inches (Ap and C horizons).

Diagnostic horizons and features recognized in this pedon:
ochric epipedon--the zone from the surface to a depth of 7 inches (Ap horizon);
Udic moisture regime.
Cation-exchange class is inferred from lab data for similar soils in the surrounding area.
Taxonomy version--second edition, 1999.
The redoximorphic features in this profile are believed to be related to the moisture status of the materials at the time of deposition and not related to present day moisture status. The redoximorphic features in this profile were not considered in the current classification of the soil.

LAKEPORT SERIES

The Lakeport series consists of very deep, somewhat poorly drained soils on flood plains. These soils formed in silty alluvium. Permeability is moderate or moderately slow. Slopes range from 0 to 2 percent. Mean annual air temperature averages 49 degrees F. Mean annual precipitation averages 29 inches.

TAXONOMIC CLASS: Fine, smectitic, mesic Aquertic Hapludolls

TYPICAL PEDON: Lakeport silty clay loam, on a nearly level flood plain, in a cultivated field, at an elevation of 1,070 feet above sea level. (Colors are for moist soil unless otherwise stated.)

Ap1--0 to 4 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to moderate very fine granular and moderate very fine subangular blocky; friable; few fine roots; few fine tubular pores; strongly acid; abrupt smooth boundary.

Ap2--4 to 12 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; friable; few fine roots; common fine tubular pores; moderately acid; clear smooth boundary.

A--12 to 22 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure parting to moderate very fine subangular blocky and moderate very fine granular; friable; few fine roots; common fine tubular pores; slightly acid; clear smooth boundary. (Combined thickness of the A horizons is 10 to 24 inches.)

Bg1--22 to 28 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate fine granular and moderate very fine subangular blocky structure; firm; few fine roots; few medium tubular pores; common distinct very dark grayish brown (2.5Y 3/2) organic coats on vertical faces of peds; neutral; clear smooth boundary.

Bg2--28 to 37 inches; dark grayish brown (2.5Y 4/2) silty clay loam; moderate very fine subangular blocky structure; firm; few distinct very dark grayish brown (2.5Y 3/2) organic coats on vertical faces of peds; neutral; clear smooth boundary.

Bg3--37 to 48 inches; dark grayish brown (2.5Y 4/2) silty clay; moderate very fine subangular blocky structure; firm; few distinct olive gray (5Y 5/2) coats on vertical faces of peds; few fine prominent dark yellowish brown (10YR 4/4) and many fine prominent light yellowish brown (10YR 6/4) redoximorphic concentrations; neutral; abrupt smooth boundary. (Combined thickness of the Bg horizons is 16 to 30 inches.)

2Cg1--48 to 58 inches; grayish brown (2.5Y 5/2) silt loam; massive; very friable; few distinct dark grayish brown (2.5Y 4/2) coats in root channels and pores; few fine prominent dark yellowish brown (10YR 4/4), many medium prominent brown (7.5YR 4/4), and common fine prominent yellowish brown (10YR 5/4) redoximorphic concentrations; strongly effervescent; moderately alkaline; clear smooth boundary.

2Cg2--58 to 64 inches; grayish brown (2.5Y 5/2) silty clay loam; massive; friable; few very fine roots; many fine tubular pores; common fine light brownish gray (2.5Y 6/2) carbonate threads; many fine prominent yellowish brown (10YR 5/6), and common fine

distinct brown (10YR 4/3) redoximorphic concentrations; strongly effervescent; moderately alkaline; abrupt smooth boundary.

3Cg3--64 to 76 inches; grayish brown (2.5Y 5/2) silty clay; massive; very firm, few very fine roots; common very fine tubular pores; few dark yellowish brown (10YR 4/6) coats in root channels and pores; few fine and medium light brownish gray (2.5Y 6/2) carbonate nodules; many fine prominent yellowish brown (10YR 5/4) and common fine distinct brown (10YR 4/3) redoximorphic concentrations; strongly effervescent; slightly alkaline; abrupt smooth boundary.

3Cg4--76 to 80 inches; grayish brown (2.5Y 5/2) clay; massive; very firm; few fine carbonate threads; few fine and medium light brownish gray (2.5Y 6/2) carbonate concretions; few fine rounded light brownish gray (2.5Y 6/2) carbonate nodules; strongly effervescent; slightly alkaline.

TYPE LOCATION: Woodbury County, Iowa; about 2 miles southwest of Sloan; about 1,840 feet west and 200 feet north of the southeast corner sec. 36, T. 86 N., R. 47 W.; USGS Albaton quadrangle; lat. 42 degrees 12 minutes 55.4 seconds N. and long. 96 degrees 15 minutes 28.2 seconds W., NAD 83

RANGE IN CHARACTERISTICS:

Thickness of mollic epipedon--16 to 24 inches
Depth to carbonates--greater than 36 inches
Content of clay in the particle-size control section (weighted average)--35 to 45 percent
Content of sand in the particle-size control section (weighted average)--less than 15 percent

Ap or A horizon:
Hue--10YR
Value--2 or 3
Chroma--1 or 2
Texture--silty clay loam or silty clay
Clay content--32 to 50 percent
Sand content--less than 20 percent
Soil reaction: strongly acid to neutral
Moist bulk density--1.20 to 1.50 g/cc
Overwash phases:
Texture--silt loam
Clay content--20 to 27 percent
Thickness--10 to 20 inches

Bg horizon:
Hue--10YR, 2.5Y, or 5Y
Value--3 or 4
Chroma--1 or 2
Texture--silty clay loam or silty clay
Clay content--35 to 48 percent

Sand content--10 to 20 percent, mostly very fine sand
Soil reaction--slightly acid to slightly alkaline
Moist bulk density--1.25 to 1.35 g/cc

C, Cg, 2Cg, or 3Cg horizon (if it occurs):
Hue--10YR or 2.5Y
Value--5 or 6
Chroma--2 to 4
Texture--very fine sandy loam, silt loam, loam, silty clay loam, clay loam, silty clay or clay
Clay content--15 to 70 percent
Sand content--1 to 70 percent
Rock fragment content--0 percent
Calcium carbonate equivalent: 2 to 15 percent
Reaction--slightly alkaline or moderately alkaline
Moist bulk density--1.10 to 1.50 g/cc

COMPETING SERIES: These are the Collinwood, Guckeen, Kandiyohi, Nameoki, and Ocheda (T) series.
Collinwood--have a moist bulk density of 1.25 to 1.40 g/cc in the lower third of the series control section
Guckeen--have a sand content of 15 to 35 percent sand coarser than very fine sand in the particle-size control section
Kandiyohi--have carbonates within a depth of 36 inches and have a moist bulk density of 1.60 to 1.80 gm/cc in the lower third of the series control section
Nameoki--are in areas where the mean annual air temperature ranges from 54 to 57 degrees F.
Ocheda (T)--have a rock fragment content of 2 to 8 percent in the lower third of the series control section

GEOGRAPHIC SETTING:
Parent material--silty alluvium
Landform--flood plains
Slopes--0 to 2 percent
Elevation--950 to 1,260 feet above sea level
Mean annual air temperature--47 to 52 degrees F.
Mean annual precipitation--26 to 32 inches
Frost-free period--145 to 175 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Blencoe, Keg, Luton, Salix, and Tieville soils.
Blencoe--are in landform positions similar to those of the Lakeport soils and have a clay content of more than 50 percent in the upper two thirds of the particle-size control section
Keg--are in higher landscape positions and have a clay content of 20 to 26 percent in the particle-size control section
Luton--are in lower positions on the landscape and have a clay content of 45 to 60

percent in the particle-size control section
Salix--are in higher positions on the landscape and have a clay content of 16 to 35 percent in the particle-size control section
Tieville--are in slightly lower positions on the landscape and have carbonates within a depth of 10 inches

DRAINAGE AND PERMEABILITY:
Drainage class--somewhat poorly drained--a saturated zone occurs within a depth of 1 to 3 feet during March to June in most years and is considered apparent
Permeability--moderate to moderately slow
Surface runoff--low
Flooding--rare for brief periods during the months of February to November from precipitation events and snowmelt

USE AND VEGETATION:
Most areas are cultivated. Corn and soybeans are principal crops. Some areas are irrigated. The native vegetation is big bluestem, indiangrass, switchgrass, and other grasses of the tall grass prairie.

DISTRIBUTION AND EXTENT:
LRR M, MLRA 107; Missouri River flood plain in Iowa and South Dakota. This series is of moderate extent.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Woodbury County, Iowa, 1971

REMARKS:
Particle-size control section--the zone from a depth of 10 to 40 inches (Ap2, A, Bg1, Bg2, and Bg3 horizons);
Series control section--the zone from the surface to a depth of 60 inches (Ap1, Ap2, A, Bg1, Bg2, Bg3, 2Cg1, and 2Cg2 horizons).
Diagnostic horizons and features recognized in this pedon:
Mollic epipedon--the zone from the surface to a depth of 22 inches (Ap and A horizons);
Cambic horizon--the zone from a depth of 22 inches to 48 inches (Bg1, Bg2, and Bg3 horizons);
Udic moisture regime.
Aquertic subgroup based on matrix color of Bg1 horizon and linear extensibility greater than 6.0 cm between the surface and a depth of 100 cm.
Taxonomy version--second edition, 1999.
Refer to DMUid 280,700 in NASIS for property data.
These soils were formerly included in certain areas of Kennebec, Monona, bench phase, and Salix soils in the previous soil survey of Woodbury County, Iowa.

ADDITIONAL DATA:
Laboratory data--National Soil Survey Laboratory, Lincoln, Nebraska pedon S95IA-193-008 (http://ssldata.sc.egov.usda.gov/).

LETA SERIES

The Leta series consists of very deep, somewhat poorly drained soils that formed in alluvium. These soils are on flood plains along major streams. Permeability is slow in the upper part and moderate or rapid in the lower part. Slopes range from 0 to 2 percent. Mean annual temperature is 55 degrees F, and mean annual precipitation is 38 inches.

TAXONOMIC CLASS: Clayey over loamy, smectitic, mesic Fluvaquentic Hapludolls

TYPICAL PEDON: Leta silty clay - on a level area in a cultivated field. at an elevation of 685 feet. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 8 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; weak fine granular structure; very firm, many fine roots; strong effervescence; slightly alkaline; abrupt smooth boundary.

A--8 to 13 inches; very dark grayish brown (2.5Y 3/2) silty clay loam, grayish brown (2.5Y 5/2) dry; moderate medium subangular blocky structure; very firm, common fine roots; strong effervescence; slightly alkaline; clear smooth boundary. (Combined thickness of the A horizon is 10 to 24 inches thick.)

Bg--13 to 25 inches; dark grayish brown (2.5Y 4/2) silty clay; moderate medium subangular blocky structure; very firm, few fine roots; few fine prominent dark yellowish brown (10YR 4/4) masses of iron accumulation throughout; strong effervescence; slightly alkaline; clear smooth boundary. (0 to 15 inches thick)

2Cg--25 to 60 inches; stratified grayish brown (10YR 5/2) very fine sandy loam and silt loam; massive with bedding planes along horizontal surfaces of strata; common fine distinct dark yellowish brown (10YR 4/4) masses of iron accumulation throughout; strong effervescence; slightly alkaline.

TYPE LOCATION: Lafayette County, Missouri; about 2 miles west of Lexington (north of Missouri River); approximately 5,000 feet west and 1,000 feet north of the southeast corner of sec. 31, T. 51 N., R. 27 W; Lexington West USGS quadrangle.

RANGE IN CHARACTERISTICS: Depth to the loamy material ranges from 20 to 38 inches. The mollic epipedon ranges from 10 to 24 inches thick. The series control section commonly is slightly alkaline or moderately alkaline throughtout, but some pedons are neutral in the upper 10 inches.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 and chroma of 1 or 2. It is silt loam, silty clay loam, or silty clay.

The Bg horizon has hue of 10YR or 2.5Y, value of 3 to 5 and chroma of 1 to 3 with distinct or prominent masses of higher chroma. If value of 3 occurs below 24 inches, it is separated from the mollic epipedon by strata of higher value. Texture is silt loam, silty clay loam, silty clay or clay and averages between 35 and 48 percent clay.

The 2Cg horizon has hue of 10YR to 5Y, value of 4 to 6 and chroma of 1 or 2 with masses of higher chroma. It commonly is stratified silt loam and very fine sandy loam, but pedons with sandy loam strata are not excluded. Some pedons have a sandy substratum below the loamy layers.

COMPETING SERIES: This is the Parkville series in the same family. Similar soils include the Blencoe, Myrick and Onawa series. Parkville soils have clayey textures to depths of less than 20 inches.
Blencoe soils are not calcareous in the upper part of the particle size control section. Myrick soils have clayey textures to a depth less than 20 inches and are wetter. Onawa soils have a thinner dark colored surface layer.

GEOGRAPHIC SETTING: Leta soils are on nearly level recent flood plains along major streams. The slope gradient is 0 to 2 percent. They formed in 20 to 38 inches of moderately fine and fine textured alluvium deposited over coarser textured alluvial materials. The mean annual temperature ranges from 53 degrees to 57 degrees F, and mean annual precipitation ranges from 35 to 42 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Haynie, Kenmoor, Modale, Myrick, Sarpy, Waldron, and Waubonsie series. The Haynie, Kenmoor, Modale, Sarpy, and Waubonsie soils have less clay in the solum and are on adjacent landscapes. Myrick soils have clayey textures to depth of less than 20
inches and are in depressions on adjacent landscapes. Waldron soils are clayey throughout and occur on adjacent landscapes.

DRAINAGE AND PERMEABILITY: Somewhat poorly drained. Runoff is low. Permeability is slow in the upper part and moderate or rapid in the lower part. An

apparent water table has an upper limit of 1.0 to 3.0 feet during November to June. These soils are subject to rare or frequent flooding.

USE AND VEGETATION: Soils are cropped to corn, soybeans, and wheat. Native vegetation is mostly willow and cottonwood.

DISTRIBUTION AND EXTENT: Along the Missouri River and its tributaries (MLRAs 107 and 115) in Missouri. These soils are of moderate extent.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Lafayette County, Missouri, 1970.

REMARKS: Diagnostic horizons and features recognized in this series are:
Mollic epipedon - the zone from the surface of the soil to a depth of 13 inches (Ap and A horizons);
Cambic horizon - the zone from approximately 13 inches to 25 inches (Bg horizon);
Udic moisture regime.
Leta soils are prime farmland where not frequently flooded.

LEVASY SERIES

The Levasy series consists of very deep, very poorly and poorly drained, calcareous, slowly over moderately permeable soils that formed in clayey alluvium over loamy alluvium. These soils are on recent flood plains of major streams. Slopes range from 0 to 2 percent. Mean annual air temperature is 56 degrees F, and mean annual precipitation is 37 inches.

TAXONOMIC CLASS: Clayey over loamy, smectitic, calcareous, mesic Fluvaquentic Endoaquolls

TYPICAL PEDON: Levasy silty clay - on a 0.5 percent slope in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 6 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate fine granular; firm; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A--6 to 17 inches; very dark grayish brown (2.5Y 3/2) silty clay, dark grayish brown (2.5Y 4/2) dry; moderate fine subangular blocky structure; firm; few fine roots; few fine prominent reddish brown (5YR 4/4) masses of iron accumulation in ped interiors; slight effervescence; mildly alkaline; clear smooth boundary. (Combined thickness of the A horizons is 10 to 24 inches.)

Bg--17 to 29 inches; dark grayish brown (2.5Y 4/2) silty clay; weak fine subangular blocky structure; firm; few fine roots; few fine prominent reddish brown (5YR 4/4) masses of iron accumulation in ped interiors; dark gray (10YR 4/1) coatings on faces of peds; strong effervescence; mildly alkaline; abrupt smooth boundary. (0 to 14 inches thick)

Cg--29 to 60 inches; stratified grayish brown (2.5Y 5/2) and dark grayish brown (2.5Y 4/2) very fine sandy loam; massive; a 2 inch layer of very dark gray (10YR 3/1) silty clay (54 to 56 inches); few fine roots; very friable; common fine distinct gray (10YR 5/1) and dark yellowish brown (10YR 4/4) and few fine prominent reddish brown (5YR 4/4) masses of iron accumulation in ped interiors; violent effervescence; mildly alkaline.

TYPE LOCATION: Platte County, Missouri; about 1 mile southwest of Beverly; 2,310 feet north and 25 feet east of the southwest corner of sec. 36, T. 53 N., R. 36 W.

RANGE IN CHARACTERISTICS: Thickness of the mollic epipedon ranges from 10 to 24 inches. The clayey surface horizons and Bg horizon are underlain at 20 to 38 inches by loamy deposits. These soils contain free carbonates throughout. Reaction is mildly alkaline or moderately alkaline.

The Ap or A horizon has hue of 10YR to 5Y, value of 2 or 3 and chroma of 1 or 2. It is silty clay loam, silty clay, or clay.

The Bg horizon has hue of 10YR to 5Y, value of 4 or 5 and chroma of 1 or 2.

The Cg horizon has hue of 2.5Y or 5Y, value of 4 to 6 and chroma of 1 or 2. It is very fine sandy loam, silt loam, loam, fine sandy loam, or loamy very fine sand. The clay percentage ranges from 12 to 27 percent. Thin strata of coarser or finer texture are commonly present.

COMPETING SERIES: These are the Myrick soils. Myrick soils have clay horizons to a depth of less than 20 inches.

GEOGRAPHIC SETTING: Levasy soils are on nearly level to slightly depressional areas on recent flood plains of the major streams. They formed in 20 to 38 inches of clayey alluvium underlain by loamy alluvium. Slope gradient is 0 to 2 percent. The mean annual temperature is 52 to 57 degrees F, and mean annual precipitation ranges from 30 to 40 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Gilliam, Haynie, Leta, Myrick, Parkville and Waldron soils. Gilliam soils have a fine-silty and Haynie soils have a coarse-silty particle size control section. Gilliam and Haynie soils occur on slightly higher areas of the flood plain. Leta soils occur on slightly higher areas of the flood plain. Myrick soils occur on similar landscapes and Parkville soils occur on slightly higher areas of the flood plain. Waldron soils are somewhat poorly drained, have a fine particle size control and are on slightly higher areas of the flood plain.

DRAINAGE AND PERMEABILITY: Very poorly and poorly drained. Runoff is very slow or ponded. Permeability is slow in the upper part and moderate in the lower part. In most years, an apparent water table has an upper limit of +0.5 to 1.0 feet where very poorly drained from November to July, and 0.0 to 1.5 feet where poorly drained from November to June.

USE AND VEGETATION: Large areas are cleared and cultivated. Corn, hay, soybeans, and wheat are the principal crops and some areas are used for pasture. Native vegetation is cottonwood trees, wetland grasses, and willow.

DISTRIBUTION AND EXTENT: Missouri River flood plain. The acreage is moderately extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Platte County, Missouri, 1982.

REMARKS: Diagnostic horizons and features recognized in this series are:
Mollic epipedon - the zone from the surface of the soil to a depth of 17 inches (Ap and A horizons).

PARKVILLE SERIES

The Parkville series consists of deep, calcareous, somewhat poorly drained soils formed in clayey over loamy alluvium on flood plains of major streams. Permeability is slow or very slow in the upper part and moderate in the lower part. Slope gradients are from 0 to 3 percent. The average annual temperature is 55 degrees F. and the average annual precipitation is 38 inches.

TAXONOMIC CLASS: Clayey over loamy, smectitic, mesic Fluvaquentic Hapludolls

TYPICAL PEDON: Parkville silty clay - in an alfalfa field on a 0.5 percent slope. (Colors are for moist soils unless otherwise stated.)

Ap--0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; strong fine granular structure in the upper part and strong very fine subangular blocky in the lower part; firm; common fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary. (4 to 10 inches thick)

A--8 to 16 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; moderate medium angular blocky structure; firm; common fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary. (6 to 10 inches thick)

2Cg1--16 to 32 inches; dark grayish brown (10YR 4/2) very fine sandy loam; few fine faint brown (10YR 4/3) mottles; massive with weak horizontal bedding planes and a pronounced bedding plane at the horizontal break; friable; common fine roots; a dark gray (10YR 4/1) silt loam discontinuous lens as much as 2 inches thick at the bottom part of the horizon; slight effervescence; mildly alkaline; abrupt smooth boundary.

2Cg2--32 to 45 inches; dark grayish brown (10YR 4/2) silt loam; massive; friable; few fine roots; a dark gray (10YR 4/1) silt loam lens as much as 1/2-inch thick at the bottom of the horizon; slight effervescence; mildly alkaline; abrupt smooth boundary.

2Cg3--45 to 60 inches; stratified dark grayish brown (10YR 4/2) very fine sandy loam and silt loam; massive; friable; slight effervescence; mildly alkaline.

TYPE LOCATION: Platte County, Missouri; 950 feet south and 125 feet east of the northwest corner of sec. 12, T. 52 N., R. 36 W.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 12 to 20 inches. Free carbonates are typically throughout the profile. The mollic epipedon averages between 10 and 20 inches in thickness.

The Ap or upper part of the A horizon has hue of 10YR or 2.5Y, value of 2 or 3, 4 or 5 dry, and chroma of 1 to 3. The lower part of the A horizon has hue of 10YR or 2.5Y, value of 2 to 4, 4 to 6 dry, and chroma of 1 to 3. Texture is silty clay loam, silty clay, or clay. Reaction is neutral to moderately alkaline.

The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 or 3. Texture is silt loam, very fine sandy loam or very fine sand and typically has thin strata of finer or coarser-textured material in the lower part of the control section. It ranges from mildly to moderately alkaline.

COMPETING SERIES: These are the Leta series in the same family and the Blencoe, Kimo, Myrick, Onawa, Percival, and Riley series. Leta soils have clayey textures to greater depths. Blencoe soils are noncalcareous above a depth of 30 inches. Kimo soils are not calcareous in their upper part and have thicker dark-colored surfaces. Myrick soils are saturated with water for significant periods. Onawa soils lack a mollic epipedon. Percival soils are clayey over sandy or sandy-skeletal. Riley soils are fine-loamy over sandy or sandy-skeletal.

GEOGRAPHIC SETTING: Parkville soils formed in deep, calcareous recent alluvium on flood plains of major streams. The clayey surface material is 12 to 20 inches in thickness and is underlain by loamy alluvium up to 10 or more feet in thickness. Slope gradients are from 0 to 3 percent. Mean annual temperature ranges from 52 to 57 degrees F. and mean annual precipitation ranges from 32 to 42 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Leta and Myrick soils and the Haynie, Kenmoor, Modale, Sarpy, and Waldron soils. Haynie, Kenmoor, Modale, and Sarpy soils are lighter colored. Waldron soils are clayey throughout the control section. Haynie, Kenmoor and Sarpy soils are closer to the streams. Leta, Modale and Waldron soils are on similar positions. Myrick soils are in depressional areas.

DRAINAGE AND PERMEABILITY: Somewhat poorly drained. Permeability is very slow or slow in the upper part and moderate in the lower part. Runoff is slow.

USE AND VEGETATION: Most areas of Parkville are cleared and cropped to corn, soybeans, wheat, alfalfa, and pasture. Native vegetation was willow and cottonwood.

DISTRIBUTION AND EXTENT: Missouri and Illinois. These soils are moderate in extent.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Platte County, Missouri, 1974.

REMARKS: Diagnostic horizons and features recognized in this series are:
Mollic epipedon-the zone from the surface of the soil to a depth of 16 inches (Ap and A horizons).

TIEVILLE SERIES

The Tieville series consists of very deep, poorly drained soils on flood plains. These soils formed in calcareous clayey alluvium. Slopes range from 0 to 2 percent. Mean annual precipitation is about 29 inches. Mean annual air temperature is about 49 degrees F.

TAXONOMIC CLASS: Fine, smectitic, calcareous, mesic Vertic Endoaquolls

TYPICAL PEDON: Tieville silty clay, in a cultivated field, on a flood plain, at an elevation of 1,055 feet above sea level. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 7 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; firm; few fine roots; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Ak--7 to 22 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; firm; few very fine and fine roots between peds; few fine irregular masses of carbonate; strongly effervescent; slightly alkaline; clear smooth boundary. (Combined thickness of the A horizon is 18 to 24 inches.)

Bkg1--22 to 30 inches; dark gray (10YR 4/1) and very dark gray (10YR 3/1) silty clay; moderate medium subangular blocky structure; firm; few fine irregular masses of carbonate; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg2--30 to 38 inches; dark gray (10YR 4/1) silty clay; moderate medium subangular blocky structure; firm; few fine irregular masses of carbonate and few fine and medium rounded carbonate concretions; common fine prominent brown (7.5YR 4/4) redoximorphic concentrations; violently effervescent; moderately alkaline; clear smooth boundary. (Combined thickness of the Bkg horizon is 12 to 36 inches thick.)

BCkg--38 to 43 inches; gray (10YR 5/1) silty clay; weak coarse prismatic structure; firm; few fine irregular carbonate concretions; common medium and coarse prominent yellowish brown (10YR 5/6) redoximorphic concentrations; strongly effervescent; moderately alkaline; clear smooth boundary. (0 to 6 inches thick)

Cg--43 to 60 inches; gray (10YR 5/1) silty clay; massive; firm; few fine irregular carbonate concretions; common medium and coarse prominent yellowish brown (10YR 5/6) redoximorphic concentrations; strongly effervescent; moderately alkaline.

TYPE LOCATION: Monona County, Iowa; about 2,500 feet north and 300 feet west of southeast corner of sec. 15, T.85 N., R.45 W.; USGS Hornick quadrangle; lat. 42 degrees 10 minutes 38 seconds N. and long. 96 degrees 3 minutes 36.1 seconds W., NAD 83

RANGE IN CHARACTERISTICS:
Depth to carbonates--0 to 10 inches

Thickness of the mollic epipedon--18 to 24 inches
Content of clay in the particle-size control section (weighted average)--40 to 60 percent
Content of sand in the particle-size control section (weighted average)--less than 10 percent fine sand and sand coarser than fine sand
Rock fragment content--0 percent
Electrical conductivity--0 dS/m

Ap, A, or Ak horizons:
Hue--10YR or 2.5Y
Value--2 or 3
Chroma--1 or 2
Texture--silty clay or clay
Clay content--40 to 60 percent
Sand content--1 to 10 percent
Calcium carbonate equivalent--1 to 5 percent
Reaction--slightly alkaline or moderately alkaline

Bg or Bkg horizons:
Hue--10YR, 2.5Y, or 5Y
Value--2 to 4
Chroma--1 or 2
Texture--silty clay or clay
Clay content--40 to 70 percent
Sand content--1 to 10 percent
Calcium carbonate equivalent--10 to 30 percent
Reaction--slightly alkaline to strongly alkaline

BCg or BCkg horizons:
Hue--10YR, 2.5Y, or 5Y
Value--3 to 5
Chroma--1 or 2
Texture--silty clay or clay
Clay content--50 to 70 percent
Sand content--1 to 10 percent
Calcium carbonate equivalent--1 to 10 percent
Reaction--moderately alkaline or strongly alkaline

Cg horizon:
Hue--10YR or 2.5Y
Value--3 to 5
Chroma--1 or 2
Texture--silty clay or clay
Clay content--50 to 70 percent
Sand content--1 to 5 percent
Calcium carbonate equivalent--1 to 10 percent
Reaction--moderately alkaline or strongly alkaline

Some pedons have a few gypsum crystals in the lower part of the series control section

COMPETING SERIES: These are the Belmann, Brownton, Egas, Erd, Herdcamp, Knoke, and Nishna series.
Belmann--have a sand content of 15 to 45 percent in the upper third of the series control section
Brownton--have a rock fragment content of 2 to 8 percent in the lower half of the series control section
Egas--have an electrical conductivity range of 8 to more than 50 dS/m in the series control section
Erd--are in areas that have an annual precipitation range of 18 to 23 inches and have an electrical conductivity range of 8 to 16 dS/m in the middle third of the series control section
Herdcamp--do not have a cambic horizon and have an electrical conductivity range of 2 to 8 dS/m in the lower two thirds of the series control section
Knoke--have a clay content of 35 to 40 percent and a sand content of 15 to 30 percent in the particle-size control section
Nishna--have a mollic epipedon 24 to 60 inches thick

GEOGRAPHIC SETTING:
Parent material--calcareous clayey alluvium
Landform--flood plains
Slopes--0 to 2 percent
Elevation--700 to 1,200 feet above sea level
Mean annual air temperature--47 to 52 degrees F.
Mean annual precipitation--26 to 32 inches
Frost-free period--145 to 175 days
GEOGRAPHICALLY ASSOCIATED SOILS: These are the Blencoe, Luton, Napa, and Woodbury soils.
Blencoe--are in the slightly higher elevations, have a clay content of 18 to 24 percent in the lower third of the particle-size control section, and have a saturated zone between depths of 1 to 3 feet during April to June in most years
Luton--are in landform positions similar to those of the Tieville soils, have carbonates between depths of 15 to 36 inches, and have a saturated zone within a depth of 1 foot during March to June in most years
Napa--are in the slightly lower elevations, have nests of gypsum and other salts within a depth of 16 inches, and have a sodium adsorption ratio of 13 in the particle-size control section
Woodbury--are in the slightly higher elevations, have a saturated zone within a depth of 1 foot, have carbonates between depths of 36 to 60 inches, and have a clay content of 20 to 35 percent in the lower third of the series control section

DRAINAGE AND PERMEABILITY:
Drainage class--poorly drained--a saturated zone occurs within a depth of 1 foot during March to June in most years and is considered apparent
Permeability--very slow

Surface runoff potential--low or negligible
Flooding--rare flooding for brief to long periods during the months of February to November from precipitation events and snowmelt

USE AND VEGETATION:
Most areas have been drained by surface ditches and are cultivated. The principal crops are corn, soybeans, and small grains. Some areas are in native range. The native vegetation is big bluestem, little bluestem, western wheatgrass, prairie cordgrass, kentucky bluegrass, blue grama, sedges and other species of the tall grass prairie that are tolerant of excessive wetness.

DISTRIBUTION AND EXTENT:
LRR M, MLRAs 102B and 107; LRR H, MLRAs 75 and 76; Iowa, Nebraska, and South Dakota. This series is of large extent.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Monona County, Iowa, 1995.

REMARKS:
Particle-size control section--the zone from a depth of 10 to 40 inches (Ak, Bkg1, Bkg2, and BCkg horizons);
Series control section--the zone from the surface to a depth of 60 inches (Ak, Bkg1, Bkg2, BCkg, and Cg horizons).
Diagnostic horizons and features recognized in this pedon:
Mollic epipedon--the zone from the surface to a depth of 22 inches. (Ap and Ak horizons);
Cambic horizon--the zone from a depth of 22 to 38 inches (Bkg1 and Bkg2 horizons);
Redoximorphic concentrations--in the zone from a depth of 30 to 60 inches (Bg2, BCg, and Cg horizons);
Aquic moisture regime.
Taxonomy version--second edition, 1999.

WABASH SERIES

The Wabash series consists of very deep, poorly and very poorly drained soils formed in alluvium. These soils are on flood plains. Slopes range from 0 to 2 percent. Mean annual air temperature is about 12 degrees C (53 degrees F). Mean annual precipitation is about 89 centimeters (35 inches).

TAXONOMIC CLASS: Fine, smectitic, mesic Cumulic Vertic Endoaquolls

TYPICAL PEDON: Wabash silty clay, on a slope of 0.5 percent, in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 15 centimeters (0 to 6 inches); very dark brown (10YR 2/2) silty clay, dark grayish brown (10YR 4/2) dry; weak and moderate fine granular structure; firm; few fine faint dark gray (10YR 4/1) iron depletions; few fine black concretions (oxides); moderately acid; abrupt smooth boundary.

A1--15 to 23 centimeters (6 to 9 inches); very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; strong fine and medium subangular blocky structure; firm; few fine faint dark gray (10YR 4/1) iron depletions; few fine black concretions (oxides); moderately acid; clear smooth boundary.

A2--23 to 48 centimeters (9 to 19 inches); black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; very firm; few pressure faces; few fine distinct dark yellowish brown (10YR 4/4) iron masses; many fine concretions (oxides); slightly acid; gradual smooth boundary. [Combined thickness of the A horizon is 46 to 71 centimeters (18 to 28 inches).]

Bg1--48 to 97 centimeters (19 to 38 inches); very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; some large spots and streaks of dark gray (5Y 4/1); moderate fine subangular blocky structure; very firm; common pressure faces; common coarse distinct

dark yellowish brown (10YR 4/4) iron masses; many fine concretions (oxides); some exteriors of peds are very dark gray (N 3/0); slightly acid; diffuse smooth boundary. [38 to 76 centimeters (15 to 30 inches) thick]

Bg2--97 to 152 centimeters (38 to 60 inches); dark gray (N 4/0) silty clay; large spots and streaks of dark gray (5Y 4/1); weak fine subangular blocky structure; common pressure faces; extremely firm; many fine concretions (oxides); slightly acid.

TYPE LOCATION: Major Land Resource Area (MLRA) 109; Livingston County, Missouri; about 4 miles south of Utica on the east side of Missouri State Highway "C"; about 799 meters (2,620 feet) south and 6 meters (20 feet) east of the northwest corner of section 7, T. 56 N., R. 24 W.

RANGE IN CHARACTERISTICS:
Thickness of the mollic epipedon--91 to 112 centimeters (36 to 44 inches)
Depth to carbonates--greater than 102 centimeters (40 inches)
Depth to redoximorphic concentrations--0 to 23 centimeters (0 to 9 inches)
Content of clay in the particle-size control section (weighted average)--40 to 60 percent
Content of sand in the particle size-control section (weighted average)--less than 15 percent
Rock fragment content--0 percent

A horizon:
Hue--10YR to 5Y or is neutral
Value--2 or 3
Chroma--0 to 2
Texture--silty clay or clay
Clay content--40 to 60 percent
Sand content--less than 5 percent
Reaction--strongly acid to neutral
Overwash phase:
Hue--10YR to 5Y
Value--2 or 3
Chroma--1 or 2
Texture--silt loam or silty clay loam
Clay content--20 to 40 percent
Sand content--5 to 20 percent
Reaction--strongly acid to neutral
Thickness--15 to 51 centimeters (6 to 20 inches)

Bg horizon:
Hue--10YR to 5Y or is neutral
Value--2 to 5
Chroma--0 to 2
Texture--silty clay or clay
Clay content--40 to 60 percent

Sand content--less than 15 percent
Reaction--strongly acid to neutral

Cg horizon (if present):
Hue--10YR to 5Y or is neutral
Value--2 to 5
Chroma--0 to 2
Texture--silty clay or clay
Clay content--40 to 60 percent
Sand content--less than 15 percent
Reaction--strongly acid to slightly alkaline

COMPETING SERIES: These are the Chehalem, Clamo, Derrynane, Okoboji, Peotone, Rantoul, Shiloh, Zoe, and Zook series.
Chechalem--have greater than 5 percent paragravel in the series control section and are in areas that have a mean annual precipitation range of 102 to 152 centimeters (40 to 60 inches)
Clamo--have carbonates within depths of 36 to 76 centimeters (14 to 30 inches)
Derrynane--have a sand content of more than 30 percent in the lower one fourth of the series control section and have 2 to 8 percent rock fragments in the lower third of the series control section
Okoboji--have carbonates within depths of 51 to 152 centimeters (20 to 60 inches), have weaker structure in the cambic horizon, contain somewhat more sand, and are in landlocked depressions
Peotone--have mollic epipedons 61 to 91 centimeters (24 to 36 inches) thick
Rantoul--have mollic epipedons 61 to 91 centimeters (24 to 36 inches) thick, have carbonates within depths of 89 to 152 centimeters (34 to 60 inches), and have a clay content of 45 to 60 percent in the particle-size control section
Shiloh--are in areas that have a mean annual precipitation range of 91 to 109 centimeters (36 to 43 inches) and have mollic epipedons 61 to 91 centimeters (24 to 36 inches) thick
Zoe--have carbonates within depths of 25 to 61 centimeters (10 to 24 inches), do not have a cambic horizon and have sodium adsorption ratio ranges from 4 to 10 within a depth of 30 centimeters (12 inches)
Zook--have a clay content of 35 to 44 percent in the particle-size control section

GEOGRAPHIC SETTING:
Parent material--alluvium
Landform--flood plains
Slopes--0 to 2 percent
Elevation--122 to 213 meters (400 to 700 feet) above sea level
Mean annual air temperature--11 to 13 degrees C (52 to 55 degrees F)
Mean annual precipitation--76 to 102 centimeters (30 to 40 inches)
Frost-free period--160 to 180 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Colo, Dockery, Vesser, and Zook soils.

Colo--are in landscape positions similar to those of the Wabash soils and have a clay content of 27 to 35 percent in the particle-size control section
Dockery--are at slightly higher elevations on floodplains, have ochric epipedons, and have a clay content of 18 to 35 percent in the particle-size control section
Vesser--are at slightly higher elevations on stream terraces, base slopes, and alluvial fans, have argillic horizons, and have a clay content of 30 to 35 percent in the particle-size control section
Zook--are in landscape positions similar to those of the Wabash soils and have a clay content of 35 to 44 percent in the particle-size control section

DRAINAGE AND PERMEABILITY:
Drainage class--poorly drained and very poorly drained--a saturated zone occurs within a depth of 0.3 meters (1 foot) March to June in most years and is considered apparent
Saturated hydraulic conductivity--low
Surface runoff potential--negligible to high
Flooding--rare to frequent flooding for brief to long periods during the months of February to November from precipitation events and snowmelt
Ponding--rare to frequent ponding, up to 0.15 meters (6 inches) in depth, for brief to long periods during the months of November to May from precipitation events and snowmelt

USE AND VEGETATION:
Drained areas are cultivated. The principal crops are corn and soybeans. The native vegetation is big bluestem, western wheatgrass, sedges, blue grama, other species of the tall grass prairie that are tolerant of excessive wetness, and scattered deciduous trees.

DISTRIBUTION AND EXTENT:
Physiographic Division--Interior Plains
Physiographic Province--Central Lowland
Physiographic section(s)--Western lake section, Dissected till plains, Till plains
MLRA(s)--Central Iowa and Minnesota Till Prairies (103), Nebraska and Kansas Loess Drift Hills (106), Iowa and Missouri Deep Loess Hills (107), Illinois and Iowa Deep Loess and Drift (108), Iowa and Missouri Heavy Till Plain (109), Central Claypan Areas (113), Southern Illinois and Indiana Thin Loess and Till Plain (114), and Central Mississippi Valley Wooded Slopes (115)
LRR M; northern Missouri, southern Iowa, Illinois, Indiana, Nebraska, Kansas, and Ohio
Extent--large

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Tippecanoe County, Indiana, 1905.

REMARKS:
Particle-size control section--the zone from a depth of 25 to 100 centimeters (10 to 40 inches) (A2, Bg1, and Bg2 horizons);
Series control section--the zone from the surface to a depth of 152 centimeters (0 to 60 inches) (Ap, A1, A2, Bg1, and Bg2 horizons).

Diagnostic horizons and features recognized in this pedon:
Mollic epipedon--the zone from the surface to a depth of 97 centimeters (0 to 38 inches) (Ap, A1, A2, and Bg1 horizons);
Cambic horizon--the zone from a depth of 48 to 152 centimeters (19 to 60 inches) (Bg1 and Bg2 horizons);
Aquic conditions--redoximorphic depletions and accumulations within in a depth of 51 centimeters (20 inches).
Vertic subgroup based on linear extensibility greater than 6.0 cm between the surface and a depth of 100 centimeters, and presence of cracks 5 millimeter or more wide through a thickness of 30 centimeters or more for some time in normal years.
Taxonomy version--second edition, 1999.

NATURAL RESOURCES CONSERVATION SERVICE

MISSOURI CONSTRUCTION SPECIFICATION

WETLAND RESTORATION

CODE 657

SCOPE

Use this construction specification for wetland restoration including the installation of water control structures.

Installation of conservation practices for wetland creation (658), wetland enhancement (659), and constructed wetland (656) may also use this construction specification.

GENERAL

Construction operations shall be carried out in such a manner and sequence that erosion and air and water pollution are minimized and held within legal limitations. **A land disturbance permit from the Missouri Department of Natural Resources may be needed if the disturbed area is greater than one (1) acre in size.**

Construction methods that enhance fish and wildlife will be used where practical. Trees stumps, and brush removed from the construction area may be piled for fish and wildlife habitat when approved by the landowner and engineer.

The completed job shall present a workmanlike appearance and shall conform to the line, grades, and elevations shown on the drawings or as staked in the field.

All operations shall be carried out in a safe and skillful manner. Safety and health regulations shall be observed and appropriate safety measures used. The contractor is responsible for having all utilities located at the site according to Missouri state laws prior to beginning work.

EARTH EMBANKMENTS

Foundation preparation

The foundation area shall be cleared of trees, logs, stumps, roots, brush, boulders, sod and rubbish. A minimum 3 inches of topsoil and sod shall be stripped from foundation area or as determined by the Engineer. Existing ditch channels crossing the foundation area shall be sloped 4 (horizontal - H):1 (vertical - V) or flatter and made deeper and wider as necessary to remove unconsolidated sediment, stumps, roots, and other objectionable material and to accommodate compaction equipment.

Excavation

To the extent needed, all suitable materials removed from the specified excavation shall be used in the construction of the planned earth embankments. Any spoil material not used in an earth embankment shall be stockpiled at locations shown on the drawings or as otherwise approved by the engineer.

Borrow excavation shall be located not closer than 30 feet to the toe of the levee so as not to cause slope stability or seepage problems.

Earthfill placement

The material placed in the fill shall be free of detrimental amounts of sod, frozen soil, stone over 6 inches in diameter (except for rock fills) and other objectionable material. To the extent they are suitable, excavated materials are to be used in the permanent fill. The distribution, moisture content, and gradation of materials shall be such that there will be no lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. Foundation areas shall be kept free of standing water when fill is being placed on them.

The placing and spreading of the fill shall be started at the lowest point of the foundation and the fill shall be brought up in approximately horizontal layers not to exceed 9 inches in thickness. Each layer shall be spread, processed, and shall be compacted by one of the following methods, as specified on the drawings:

> Dozer - Complete coverage by tread or track of hauling or spreading equipment. Each lift shall not exceed 5 inches in thickness. Low ground pressure dozers (less than 6.5 psi) may not be used for compaction.
>
> Roller - two passes of standard tamping type roller over the entire area to be compacted. Complete coverage by the treads of loaded hauling equipment is considered equivalent to two (2) passes of tamping roller. Each lift shall not exceed 9 inches in thickness.
>
> The tamping-type roller shall have tampers or feet projecting not less than six (6) inches from the surface of the drum and shall have a minimum static load on each tamper of 250 pounds per square inch of tamping area. Tamping rollers with minimum static load on each tamper of 125 pounds per square inch of tamping area may be used if the number of passes is increased to four (4) or the thickness of lifts is reduced to four (4) inches. (Sheepsfoot or wedgefoot drum rollers are considered tamping rollers.)

Embankments shall be constructed to lines and grades shown on the drawings. Finish grade shall be smooth, uniform, and ready for seedbed preparation.

Moisture control

The moisture content of the fill material and foundation shall be such that the required compaction can be obtained. The minimum moisture content of fill material and foundation shall be such that when kneaded in the hand, the fill material will form a ball which does not readily separate. The maximum moisture content is when conditions are too wet for efficient use of the hauling and compaction equipment.

Borrow areas

All borrow areas shall be graded and left so they are protected from erosion and may be seeded. Borrow areas inside the pool area shall have side slopes of 4(H):1(V) or flatter.

EXCAVATED POOLS

Pools shall be excavated to the depths, dimensions and slopes as shown on the plans and as staked in the field. Excavated materials shall be placed in areas the designated on the plans.

If permeable layers, such as clean sands, are encountered during the excavation contact the engineer for sealing methods and requirements.

PIPES, WATER CONTROL STRUCTURES AND SPILLWAYS

Materials

Materials required and fabrication details shall be as specified on the drawings and as shown below.

Concrete and reinforcing steel shall conform to Construction Specification 750.

Rock riprap and bedding shall be sound, durable rock conforming to gradation shown on drawings. Geotextile may be used in lieu of riprap bedding. Metal, concrete blocks, and drain materials shall be as shown on the drawings.

Geotextile fabric shall be non-woven, needle punched conforming to construction Specification 753, Geotextile.

Treated lumber shall be No. 2 grade or better, pressure treated with 0.4 pounds per cubic foot of Copper Chromate Arsenate (CCA) or equivalent. All other lumber shall be as shown on drawings.

Water control structures and pipes shall be of the type, configuration, size and materials as specified on the plans or the Additional Details section of this specification. The specified pipe materials shall have the following properties:

Solid wall polyvinyl chloride pipe (PVC) shall be 1120 or 1220 conforming to ASTM (American Society of Testing and Materials) D1785, ASTM D2241, AWWA C900 or equivalent. The SDR 35 PVC plastic pipe shall conform to ASTM D3034.

Corrugated PVC pipe with smooth interior shall conform to ASTM F949 and ribbed PVC pipe with a smooth interior shall conform to ASTM F794 with a minimum pipe stiffness of 46 pounds per square inch.

Corrugated polyethylene heavy duty tubing with smooth interior wall and pipe stiffness of 45 pounds per square inch shall be used.

Welded steel pipe shall be new and shall have a minimum nominal wall thickness of ¼ inch conforming to ASTM A53 or API (American Petroleum Institute) 5L or equivalent. If specified on the drawings or Additional Details section of this specification the pipe may be used if of good quality with no pitting, splitting or scaling with a minimum nominal wall thickness of ¼ inch.

Corrugated metal pipe shall conform to the requirements of ASTM A760, A762, A885, B745, or B790 as appropriate.

Anti-seep collars when required shall be of materials compatible with the pipe.

All pipe joints, couplers and fittings shall be compatible with the pipe, shall be installed according to the manufacturer's recommendations and shall provide a watertight connection.

Installation

Pipe conduits shall be placed on a firm foundation to the lines and grades shown on the drawings. The pipe foundation shall be covered with 1 inch of loose, moist, friable ML or CL soil material immediately prior to pipe placement.

Anti-seep collars when required are to be installed at locations shown on the drawings with watertight connections.

Selected backfill of friable ML or CL material shall be placed around structures, pipe conduits and anti-seep collars at approximately the same rate on all sides to prevent unequal pressures. Rubber tire, hand, or manually directed power tamper will be used on backfill around all conduits

or structures. A maximum of 4 inch lifts shall be used for hand compaction and 6 inches lifts for rubber tired and manually directed power tampers. Extreme caution must be exercised in backfill and compaction around structures or conduits to prevent damage, movement, or deflection. Compaction on the bottom half of conduits must be firm to fill all voids and supply lateral support. Light weight conduits may need to be held in place to prevent uplift during compaction.

Equipment shall not be operated over any structure or conduit until there is sufficient backfill to prevent damage. This minimum cover is 3 feet for PVC pipe and 2 feet for welded steel pipe.

If coated CMP is to be used, it shall be handled in such manner as to avoid damage to the coating. All damaged areas of the pipe coating shall be repaired in accordance with the manufacturer's recommendations.

VEGETATION

Topsoil shall be added, if needed, to establish vegetation. Refer to JS-AGRON-25 for seeding and mulching recommendations or equivalent

Additional Details:_____

NATURAL RESOURCES CONSERVATION SERVICE
MISSOURI OPERATION AND MAINTENANCE

WETLAND RESTORATION

CODE 657

OPERATION AND MAINTENANCE

- Inspect water control structure to ensure it is not damaged and is operating properly. Remove any woody material, debris, or growing timber that is interfering with the efficient use of the water control structure.
- Mow grass and weeds near any plastic pipe to reduce chance of fire damaging the pipe during vegetative maintenance.
- Inspect vegetation in wetlands. Some treatment may be needed to control undesirable vegetation.
- Repair water control structure and levee (levee) as soon as possible after damage is observed.
- Reestablish vegetative cover on levee (levee) immediately where erosion has removed established seeding.
- Maintain effective erosion control of the contributing watershed (drainage area) to prevent siltation and the resulting loss of capacity.
- Inspect levees for damage from burrowing animals such as muskrats. Some rodent control may be required to remove the hazard.

Additional Details:_____

_____

_____

_____

_____

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WETLAND RESTORATION

(Ac.)

CODE 657

DEFINITION

The rehabilitation of a degraded wetland or the reestablishment of a wetland so that soils, hydrology, vegetative community, and habitat are a close approximation of the original natural condition that existed prior to modification to the extent practicable.

PURPOSE

To restore wetland function, value, habitat, diversity, and capacity to a close approximation of the pre-disturbance by:

- Restoring hydric soil
- Restoring hydrology (depth duration and season of inundation, and/or duration and season of soil saturation).
- Restoring native vegetation (including the removal of undesired species, and/or seeding or planting of desired species).

CONDITIONS WHERE PRACTICE APPLIES

This practice applies only to natural wetland sites with hydric soils, or problem soils that are hydric, which have been subject to hydrologic or vegetative degradation, or to sites where hydric soils are covered by fill, sediment, or other deposits.

This practice is applicable only where the natural hydrologic conditions, including the hydroperiods, can be approximated by modifying drainage and/or by artificial flooding of a duration and frequency similar to the original, natural conditions.

This practice does not apply:

- to treat point and non-point sources of water pollution (Constructed Wetland - 656);
- to modify an existing wetland where specific attributes are heightened by management objectives, and/or returning a degraded wetland back to a wetland but to a different type than what previously existed on the site (Wetland Enhancement - 659);
- to creating a wetland on a site location which historically was not a wetland (Wetland Creation - 658).

Where water management levees (sometimes referred to as dikes or berms) are a component of the restoration, this standard is applicable to:

Low hazard structures with structural heights of 6 feet or less (structural height is the difference in elevation between the lowest point on the levee top and the elevation of the natural foundation at the lowest toe of the levee, except where crossing a gully or ditch.)

Depending upon the purpose, embankment structures exceeding the above criteria will be designed in accordance with either:

Conservation Practice Standard Dike (356).

or

Conservation Practice Standard Pond (378). Embankments exceeding the Pond (378) criteria will be designed in accordance with NRCS Technical Release 60 - Earth Dams and Reservoirs.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resource Conservation Service or download the standard from the electronic Field Office Technical Guide for Missouri.

CRITERIA

General Criteria Applicable to All Purposes

The purpose, goals and objectives of the restoration shall be clearly outlined, including soils, hydrology and vegetation criteria that are to be met and are appropriate for the site and the project purposes.

The soil, hydrology and vegetative characteristics existing on the site and the contributing watershed shall be documented before restoration of the site begins.

The nutrient and pesticide tolerance of the species planned shall be considered where known nutrient and pesticide contamination exists.

Upon completion of the restoration, the site shall meet soil, hydrology, vegetation and habitat conditions of the wetland that previously existed on the site to the extent practicable.

Where offsite drainage or the presence of invasive species impact the site, the design shall compensate for these landscape changes to the extent practicable (e.g., increased water depth, berms or microtopography).

Sites suspected of containing hazardous waste shall be tested to identify appropriate remedial measures. Sites containing hazardous material shall be cleaned prior to the installation of this practice.

Invasive species, federal/state listed noxious plant species, and nuisance species (e.g., those whose presence or overpopulation jeopardize the practice) shall be controlled on the site. This includes the manipulation of water levels to control unwanted vegetation. The establishment and/or use of non-native plant species shall be discouraged where possible.

Complete the Wetland Planning Checklist, Appendix A, National Engineering Handbook (NEH), Part 650, Engineering Field Handbook (EFH), Chapter 13 - Wetland Restoration, Enhancement, or Creation or similar documentation (WRP pre-plan) and MO-CPA-52 "Environmental Analysis for Conservation Planning".

Criteria for Hydric Soil Restoration

Restoration sites will be located on hydric soils, or on problem soil areas that are hydric.

If the hydric soil is covered by fill, sediment, spoil, or other depositional material, the material covering the hydric soil shall, to the extent technically feasible, be removed.

Side slopes and wetland shape and size should approximate the original configuration. When this cannot be determined, excavated areas shall have the following characteristics;

(1) Excavated side slopes shall be 6 (horizontal-H):1 (vertical-V) or flatter;

(2) The wetland edge shall have an irregular shoreline;

and

(3) When possible, place a minimum 25 feet wide vegetated buffer surrounding the excavated area.

Criteria for Hydrology Restoration

The hydrology (including the timing of inflow and outflow, duration, and frequency) and hydroperiod of the restored site shall approximate the conditions that existed before alteration. This includes affects to hydrology restoration caused by roads, ditches, drains, terraces, etc. within the watershed.

The work associated with the wetland shall not adversely affect adjacent properties or other water users unless agreed to by signed written letter, easement or permit. This includes but is not limited to adverse affects relating to surface water impoundment, surface water drainage, subsurface water drainage and flood water surface profiles. Floodplain sites with water management levees greater than 3 feet in height or where the restored wetland pool occupies more than 30% of the available floodplain shall be analyzed for pre and post development flood conditions.

A natural water supply should be used to reestablish the site's hydrology that approximates the needs of the wetland type. If this is not possible, an artificial water supply can be used; however, these sources shall not be diverted from other wetland resources (e.g. prairie pothole wetland complexes or springs).

Use a water budget to evaluate sites receiving limited upland runoff, limited floodwater (backwater), and no diverted or pumped water to assure the planned hydrologic conditions will exist and to minimize levee height.

To the extent technically feasible reestablish topographic relief and/or microtopography. Use reference sites within the area to determine desired topographic relief.

Excavations from within the wetland shall remove sediment to approximate the original topography and/or microtopography or establish a water level that will compensate for the sediment that remains.

Existing drainage systems will be utilized, removed or modified as needed to achieve the intended purpose.

Subsurface Drain Removal or Destruction. In areas where subsurface drains were used to remove surface water or soil saturation, the existing system shall be modified to restore the wetland hydrologic conditions. Review of drainage records, interviews, and site investigations will be needed to determine the extent of the existing system.

The effects of the subsurface drainage system may be eliminated by the following:

(1) removing or rendering inoperable a portion of the drain at the downstream edge of the site;

(2) modifying the drain with a water control device;

or

(3) installing non-perforated pipe through the wetland site.

The minimum length of drain to be removed or rendered inoperable is shown in Table 1.

All sand and gravel bedding and filtering material or other flow enhancing material will also be removed. The trench shall be filled and compacted to achieve a soil density equal to adjacent material.

Where levees will be constructed, all subsurface drains shall be removed starting at the minimum distance shown on Table 1 downstream of the levee centerline and extending an additional 15 feet upstream from the upstream toe of the levee.

Where surface water inlets are provided for wetland water level control, existing drains downstream of the site shall be protected by flow control devices.

The water control structure will be attached to a non-perforated conduit that extends at least the minimum length specified in Table 1. The connections of the water control structure and non-perforated pipe will be watertight at the head created at the maximum pool level.

Disconnected subsurface drains downstream of the wetland shall have an end cap installed or shall be plugged on the upstream end to prevent soil from entering the drain.

Table 1

Minimum length of subsurface drain to be removed or rendered inoperable or minimum length of surface drain to be filled.

Permeability1 (inches per hour)	Soil Texture1	Minimum Distance2 (feet)
Greater than 2.0	Sand	150
0.6 - 2.0	Loam	100
Less than 0.6	Clay	25

1/ Texture and permeability are for the general profile. Where the permeability and texture vary throughout the profile, consider the type of drainage system and which layer(s) are critical. Standard values for permeability and texture for each soil map unit are in the Field Office Technical Guide.

2/ The length is measured parallel to the direction of the surface drain flow.

Surface Drain Removal. Where an open channel has been constructed to drain the wetland, the channel will be filled with earthfill or controlled with a grade stabilization structure to restore the wetland hydrologic conditions. A water control structure may be required to manage water levels for wetland operation and maintenance.

The channel may be blocked with earthfill without a flow control device where flow duration and rate will not cause erosion and head cutting. The minimum length of channel to be filled will be as shown in Table 1.

The side slopes of channel blocks shall be 6 (H):1(V) or flatter. Settled height of a channel block shall be at least 0.5 feet higher than the adjacent overflow area. All fill shall be compacted to achieve the density of adjacent materials. For channel blocks higher than 3 feet, the earthfill height shall be increased by at least 5 percent for settlement and foundation consolidation.

Micro- / Macro- Topography. (Micro topographic features are those less than 6 inches of relative elevation change. Macro topographic features are those greater than 6 inches of relative elevation change.) Excavated borrow areas and pools and spoil mounds shall mimic natural floodplain features such as oxbows, scour areas, channel remnants, high banks and depositional ridges. Slopes, depths, and edges of excavated pools should be variable and irregular. Excavated pools should be located in areas least likely to have excessive sediment deposition during natural flood events.

Water Management Levees. An earth levee may be constructed to create a pool storage volume equal to that which existed prior to conversion of the site or larger in size.

Generally, borrow of fill materials shall not be closer than 30 feet from either toe of the levee, except where the existing borrow channel approaches the water control structure. If possible, creative borrow that replicates natural wetlands such as old meandering stream channels, oxbows, or depressional wetland areas should be utilized.

Levees in riverine settings are to be designed and constructed with flooding considerations in mind. Levees need adequate slopes to accommodate overtopping, need to be constructed with a consistent elevation so as not to channel water in a particular area, and should be constructed higher in elevation for 30 to 100 feet on both sides of the water control structure for additional protection. Earth spillways should be placed in levees, which will allow water to back into wetland from the downstream end and not channel water through the wetland or allow headwater flooding, except where scouring is advantageous. Elevation differences between the spillway and the water control structure should be minimized. Earth spillways need to be placed in areas that do not channel floodwater against constructed levees or water control structures.

Care is to be taken to design levees so that they do not restrict floodwater from entering a wetland when backwater flooding is a primary water source.

In some cases, it may be desirable to take borrow from the upper portions of the proposed pool so as to extend the pool outward and flatten the proposed pool to enhance management capability for migratory birds.

Structures shall not encroach upon a floodway delineated on a FEMA Flood Insurance Rate Map without certification from the regulating authority for the floodway.

General Water management LEVEE criteria.

Top Width – 10 feet minimum. Consider a wider top in overflow areas.

Side Slopes – 4 (horizontal - H):1 (vertical - V) or flatter, in non-overflow areas and 6:1 or flatter in overflow areas.

Settlement – The constructed height shall be increased by 5 percent when height is higher than 3 feet. Fills 3 feet in height and under do not need any additional settlement height added.

Site Preparation – Debris and vegetation must be removed from the embankment foundation area as well as topsoil stockpiled for later use. Include a cutoff trench as needed to reduce seepage losses.

Earth Spillway – The spillway shall act as a relief section in the levee for the safe release of design storm flows or to allow the pool to fill from backwater flooding before the levee overtops. The earth spillway will allow excess water to exit prior to tailwater retreating. Design earth spillways according to criteria given in Table 2.

Vegetated spillways shall be located in either excavated natural ground or on compacted fill. Vegetated spillways shall have a minimum crest length of 20 feet with inlet and exit slopes of 8:1 or flatter.

Evaluate reverse pool filling (from an adjacent channel) using USGS stream flow data or other appropriate methods. In the absence of stream flow data, the minimum capacity for

reverse pool filling shall be 1 cfs per ac-ft of pool volume between the normal pool and the spillway crest using 1/2 the available spillway flow depth. For further details refer to EFH, Chapter 13.

Water Control Structure. Water control structures will be used when it is desirable to control or manipulate the water level for operation and maintenance of the wetland at an elevation different than that caused by blocking the channel. Structures shall meet the requirements of Conservation Practice Standard Structure for Water Control (587).

The water control structure shall be designed and installed in a manner to prevent internal soil erosion (piping) through or around all appurtenances.

Water control structures will have the ability to drawdown wetland pools at the rates listed in Table 2. The structure must automatically regulate the pool to the desired elevation unless provisions are made for personnel to be available to operate the structure. For further details refer to EFH, Chapter 13.

Avoid placing a water control structure in an inside levee corner since debris tends to gather over structures and beaver problems may be severe.

Spillway Pipes for Embankments. Where there is runoff from a contributing drainage area or a prolonged low flow or a base flow, a pipe or armored principal spillway will be used. The water control structure may function as the spillway when feasible.

Required principal spillway discharges for conveying runoff are shown in Table 2. The principal spillway flow plus any detention storage must handle the design storm shown in Table 2 without flow through the earth spillway.

Spillways to handle base flows shall convey at least twice the base flow rate.

The outlet section of pipes shall extend at least 1 foot beyond the toe of the downstream levee sideslope or to a safe outlet.

For wetland pools with surface areas greater than 10 acres, the minimum pipe diameter shall be 12 inches. For wetland pools with surface areas 10 acres or less the minimum pipe diameter shall be 6 inches. The minimum weir length of any inlet structure shall be 14 inches regardless of pipe diameter.

Only new smooth steel pipe, concrete pipe or solid wall plastic pipe shall be used for wetlands restored under a perpetual easement situation.

The SDR or DR of PVC pipe shall be 35 or less for fill heights 10 feet or less.

Use anti-seep collars as needed on structures with permanent marshes or areas where permanent water will be held against the levee. When structural levee height exceeds 6 feet the anti-seep requirements of Conservation Practice Standard and Specification Pond (378) Standard shall be met. For further details refer to EFH, Chapter 13.

Structure and Drain Protection. All surface water inlet structures shall be equipped with trash racks to exclude debris if debris is present that could plug the pipe.

Downgrading of Flood Protection Dikes. Existing flood protection dikes may be modified by downgrading, breaching or complete removal to restore the connection of the wetland area to the original floodplain. Flood protection dikes will only be modified if no adverse effects will occur to adjacent lands and property.

If not completely removed, the dike shall be downgraded or breached in such a manner as to limit scour and erosion of the remaining dike embankment during flood events.

Vegetation on Levees and Spillways. Immediately after construction and prior to holding water against the newly constructed levee the entire levee and spillway area shall have a protective vegetative cover established. Use Conservation Practice Standard Critical Area Planting (342) for seeding recommendations with the exception that Reed Canarygrass will not be used.

Criteria for Vegetative Restoration

Hydrophytic vegetation restoration shall be of species typical for the wetland type(s) being established. Preference shall be given to native wetland plants with localized genetic material.

Where natural colonization of pre-identified, selected species will realistically dominate within 5 years, sites may be left to revegetate

naturally. If a site has not become dominated by the targeted species within 5 years, active forms of revegetation may be required.

Adequate substrate material and site preparation necessary for proper establishment of the selected plant species shall be included in the design.

Where planting and/or seeding is necessary, the minimum number of native species to be established shall be based upon the type of vegetative communities present and the vegetation type planned:

- Where the dominant vegetation will be herbaceous community types, a subset of the original vegetative community shall be established within 5 years; or, a suitable precursor to the original community will be established within 5 years that creates conditions suitable for the establishment of the native community. Species richness shall be addressed in the planning of herbaceous communities.
- Where the dominant vegetation will be forest or woodland community types, vegetation establishment will include a minimum of six species. Seeding rates shall be based upon percentage of pure live seed that shall be tested within 6 months of planting.

CONSIDERATIONS

It is expected that for wildlife purposes, planting density and stocking rates will generally be lower than for production purposes, and that the selection of species will generally be different than those used for production purposes.

On sites where woody vegetation will dominate, consider adding 1 to 2 dead snags, tree stumps or logs per acre to provide structure and cover for wildlife and a carbon source for food chain support.

Consider impact that water surface draw-downs will have on concentrating aquatic species such as turtles into diminished pool area resulting in increased mortality.

Consider existing wetland functions and/or values that may be adversely impacted.

Consider the effect restoration will have on disease vectors such as mosquitoes.

Consider effect of volumes and rates of runoff, infiltration, evaporation and transpiration on the water budget.

Consider effects on downstream flows or aquifers that would affect other water uses or users.

Consider the effect of water control structures on the ability of fish or other aquatic species to move in and out of the wetland.

Consider establishing herbaceous vegetation by a variety of methods over the entire site, or a portion of the site, and at densities and depths appropriate.

Consider effects on wetlands and water-related resources, including fish and wildlife habitats, which would be associated with the practice.

Consider linking wetlands by corridors wherever appropriate to enhance the wetland's use and colonization by the native flora and fauna.

Consider establishing vegetative buffers on surrounding uplands to reduce sediment and soluble and sediment-attached substance carried by runoff and/or wind.

Consider effects on temperature of water resources to prevent undesired effects on aquatic and wildlife communities.

Consider the effects of soil disturbance and probability of invasion by unwanted species.

For discharge wetlands, consider underground upslope water and/or groundwater source availability.

Consider microtopography and hydroperiod when determining which species to plant.

Consider controlling water levels to prevent oxidation of organic soils and inundated organic matter and materials.

PLANS AND SPECIFICATIONS

Plans and Specifications for this practice shall be prepared for each site. Specifications shall be recorded using approved specifications sheets, job sheets, narrative statements in the

conservation plan, or other documentation. Requirements for the operation and maintenance of the practice shall be incorporated into site specifications. Plans and specifications should be reviewed by staff with appropriate training in design and implementation of wetland restoration. NRCS staff is encouraged to work closely with the NRCS Biologist, Missouri Department of Conservation Biologist, or other wetland specialist to develop site specific plans and specifications.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance):

Any use of fertilizers, mechanical treatments, prescribed burning, pesticides and other chemicals shall assure that the intended purpose of the wetland restoration shall not be compromised;

Biological control of undesirable plant species and pests (e.g., using predator or parasitic species) shall be implemented where available and feasible;

Establish an inspection schedule for embankments and structures for damage assessment;

The depth of accumulated sediment should be measured and the accumulations removed when the planned project objectives are jeopardized.

Management actions shall maintain vegetation, and control undesirable vegetation.

For wildlife habitat purposes, haying and grazing, if justified as a necessary wildlife/wetland management tool, can be used for management of vegetation. Disturbance to ground nesting species shall be minimized.

The control of water depth and duration may be utilized to control unwanted vegetation.

REFERENCES:

Executive order 13112, Invasive Species, February 3, 1999. Federal Register: Vol.64, No.25. Feb. 8, 1999.

Galatowitsch, Susan, et al, 1994. Restoring Prairie Wetlands: an ecological approach. Iowa State University Press, Ames IA. 246 pp.

Hall, C.D. and F.J. Cuthbert. 2000. Impact of a controlled wetland drawdown on Blanding's Turtles in Minnesota. Chelonian Conservation Biology. Vol. 3, No. 4, pp. 643-649Hurt, G.W. and V.W. Carlisle, 2001. Delineating Hydric Soils, in Wetland Soils – Genesis, Hydrology, Landscapes and Classification. Edited by J.L. Richardson and M.J Vepraskas. CRC Press, Boca Raton, FL pp. 183 – 206.

Kingsbury, Bruce & Joanne Gibson, 2002. Habitat Management Guidelines for Amphibians and Reptiles of the Midwest. Partners in Amphibian & Reptile Conservation, Ft Wayne IN, 57 pp.

M.J. Vepraskas ands S. W. Sprecher editors, 1997. Aquic Conditions and Hydric Soils: The Problem Soils. Soil Science Society of America Special Publication Number 50. SSSA, Inc. Madison, WI.

Maschhoff, Justin T & James H. Dooley, 2001. Functional Requirements and Design Parameters for Restocking Coarse Woody Features in Restored Wetlands, ASAE Meeting Presentation, Paper No. 012059.

USDA, NRCS, 2003. ECS 190-15 Wetland Restoration, Enhancement, Management & Monitoring. 425 pp.

USDA, NRCS. Wetland Restoration, Enhancement, or Creation, Engineering Field Handbook Chapter 13, Part 650, pp. 3, 24, 77, 78.

USDA, NRCS. 2002. Field Indicators of Hydric Soils in the U.S., Version 5.0. G.W. Hurt, P.M. Whited and R.F. Pringle (eds.). USDA, NRCS in cooperation with the National Technical Committee for Hydric Soils, Fort Worth, TX.

Table 2

Minimum Drawdown and Spillway Discharge Capacity

Local Drainage Area* to Pool Area Ratio (Acre : Acre)	Principal Spillway Minimum Design Storm (24 hour duration)	Auxiliary Spillway Minimum Design Storm** (24 hour duration)	Water Control Structure Draw Down Requirement
Between 1:1 and 3:1 And Drainage Area 20 ac or less with a good auxiliary spillway condition	None required, water control structure for draw down only if needed for management. Set auxiliary spillway at permanent pool elevation.	2 year Or Size for back water flooding Whichever is greater	Capacity to remove 85% of the normal pool volume in 5 to 14 days with consideration given to management objectives, (with boards pulled or valves open)
Between 1:1 and 5:1	Set auxiliary spillway 0.5 foot higher than principal spillway with spillway sized to drawdown the upper 1" of the auxiliary spillway crest pool volume in 24 hours with WCS boards in or valves closed. Or 1 year storm event without flow through auxiliary spillway	2 year Or Size for back water flooding Whichever is greater	
Greater than 5:1	2 year storm event without flow through auxiliary spillway	5 year Or Size for back water flooding Whichever is greater	

*Drainage area includes pool area.

**Auxiliary spillway shall have a minimum depth of 0.3 feet. Auxiliary spillway design flow depth shall be a maximum of 0.5 feet if levee is expected to be overtopped on a yearly basis during flood events on adjacent channel.

CONFLUENCE POINT STATE PARK

ST. CHARLES COUNTY

WEST ALTON, MISSOURI

EDWARD (TED) AND PAT JONES – CONFLUENCE POINT STATE PARK MISSOURI RIVER FISH AND WILDLIFE MITIGATION PROJECT

SOLICITATION NO. W912P9–08–

US Army Corps
of Engineers
St. Louis District

Leaders in Customer Care

MAY 2008

VICINITY MAP

NO SCALE

LOCATION MAP

NO SCALE

CONTRACT DRAWINGS

DRAWING NO. M-LM-H	TITLE
	COVER
	GENERAL
G-1	INDEX OF DRAWINGS, PROJECT LOCATION AND VICINITY MAPS
	CIVIL
C-1	PLAN - MITIGATION PROJECT
C-2	PLAN - PIPELINE CROSSINGS
C-3	PLAN - POOL 3
C-4	PLAN - S1, S2, S3, SPOIL 1 & 2
C-5	PLAN - POOL 1
C-6	PLAN - POOL 3 & POOL 4
C-7	PLAN - POOL 5, POOL 6, S5
C-8	PLAN - D2, S4-S9
C-9	BERM AND ISLAND WITH ADJACENT AREA TYPICAL CROSS SECTION SECTION

US Army Corps of Engineers
ST. LOUIS DISTRICT

U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT
ST. LOUIS, MISSOURI

LOWER MISSISSIPPI RIVER BASIN
MISSOURI, ILLINOIS, IOWA
ST. CHARLES COUNTY

PORTAGE TITLE: SIX FLAGS, CONFLUENCE STATE PARK
MISSOURI RIVER MILE 19.0 TO MISSISSIPPI RIVER MILE 0.0
MISSOURI
GENERAL
INDEX OF DRAWINGS
PROJECT LOCATION AND VICINITY MAPS

M-LM-H/G-1

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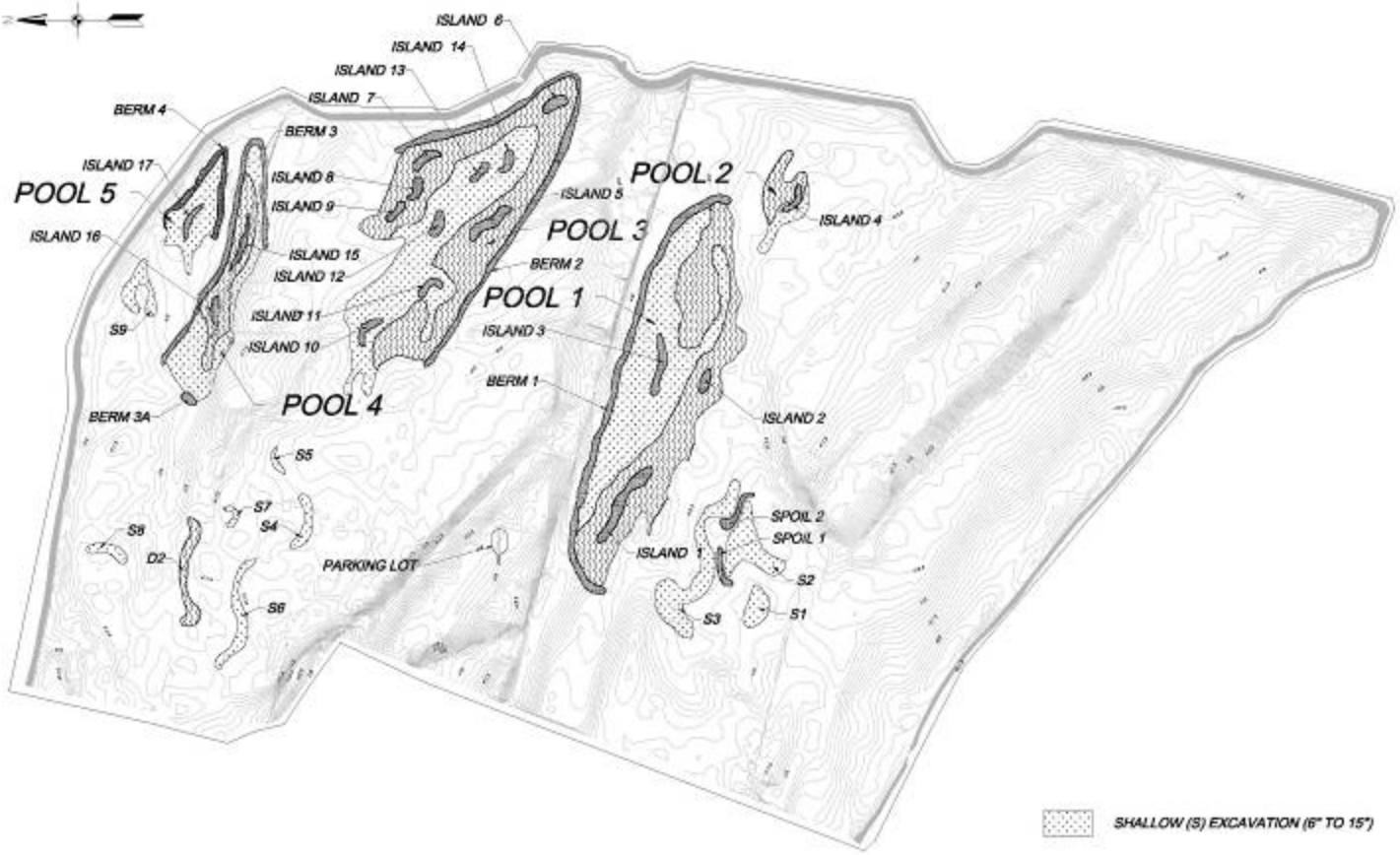


SHALLOW (S) EXCAVATION (6" TO 15")

DEEP (D) EXCAVATION (14" TO 18")

PLAN - MITIGATION PROJECT

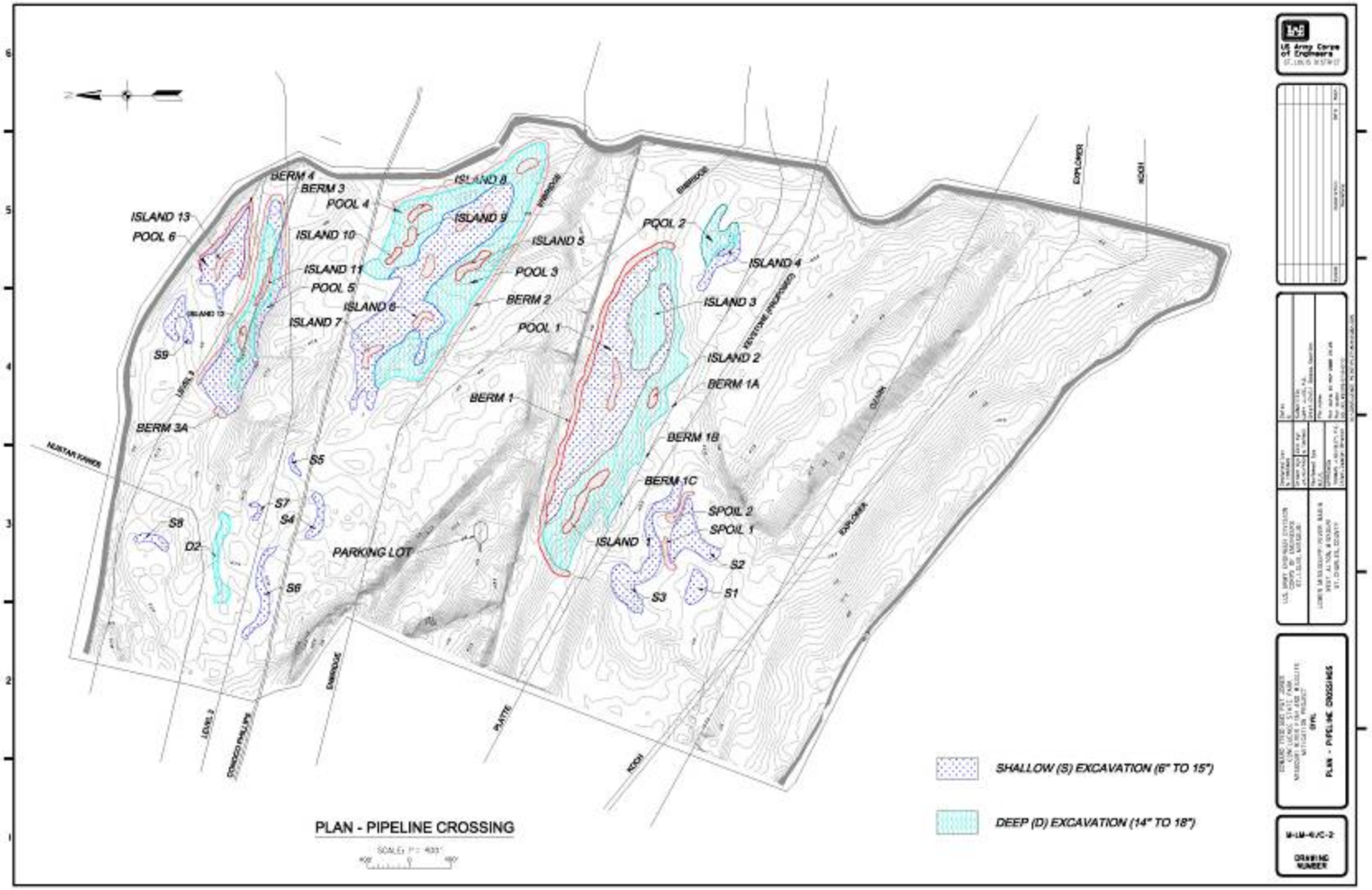
SCALE: 1" = 400'

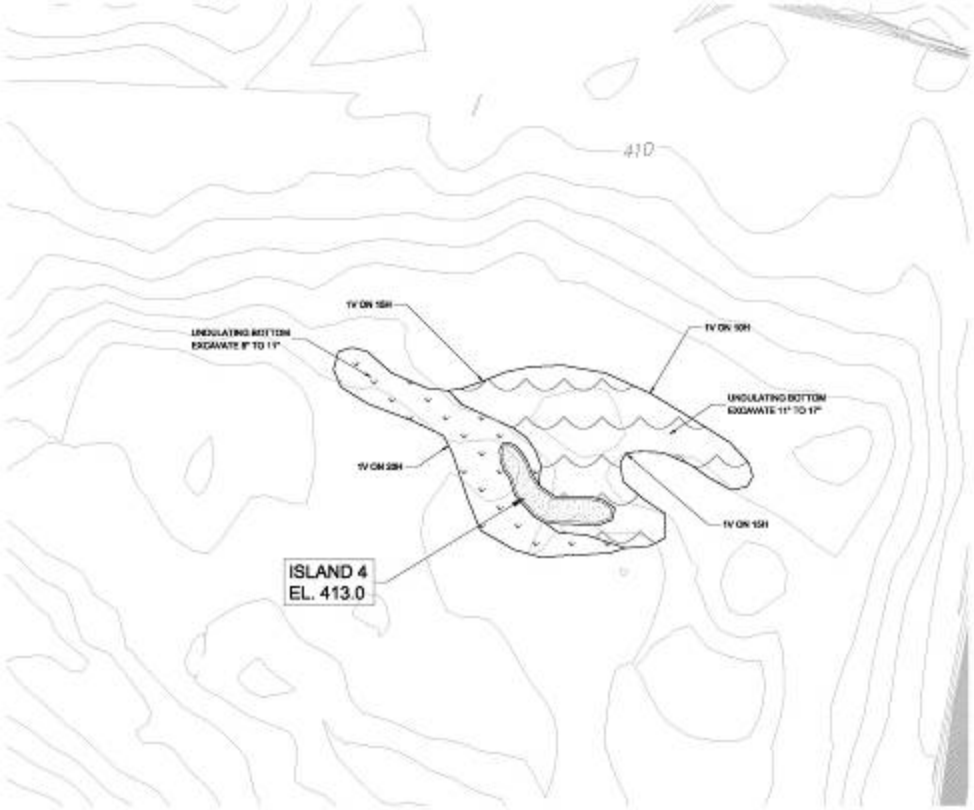
US Army Corps of Engineers
ST. LOUIS DISTRICT

PLAN - MITIGATION PROJECT

M-LM-4/C-1

DRAWING NUMBER


BERM 4
BERM 3
POOL 4
ISLAND 8
ISLAND 13
POOL 6
ISLAND 10
ISLAND 9
ISLAND 5
POOL 2
ISLAND 4
ISLAND 11
POOL 5
POOL 3
ISLAND 6
BERM 2
ISLAND 3
ISLAND 7
POOL 1
ISLAND 2
S9
BERM 1A
BERM 1
BERM 3A
BERM 1B
S5
BERM 1C
S7
S4
SPOIL 2
SPOIL 1
S8
D2
PARKING LOT
ISLAND 1
S2
S6
S3
S1
SHALLOW (S) EXCAVATION (6" TO 15")
DEEP (D) EXCAVATION (14" TO 18")
PLAN - PIPELINE CROSSING
US Army Corps of Engineers
ST. LOUIS DISTRICT
PLAN - PIPELINE CROSSINGS
M-LM-4/C-2
DRAWING NUMBER



PLAN - POOL 2

SCALE: 1" = 200'

SHALLOW (S) EXCAVATION (6" TO 15")

DEEP (D) EXCAVATION (14" TO 18")

US Army Corps of Engineers
ST. LOUIS DISTRICT

SYMBOL	DATE	REVISION

DESIGNED BY
DRAWN BY
CHECKED BY
SUPERVISED BY
DATE
SOLICITATION NO.
CONTRACT NO.
FILE NAME
FILE NUMBER
PLOT SCALE
PLOT DATE

U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

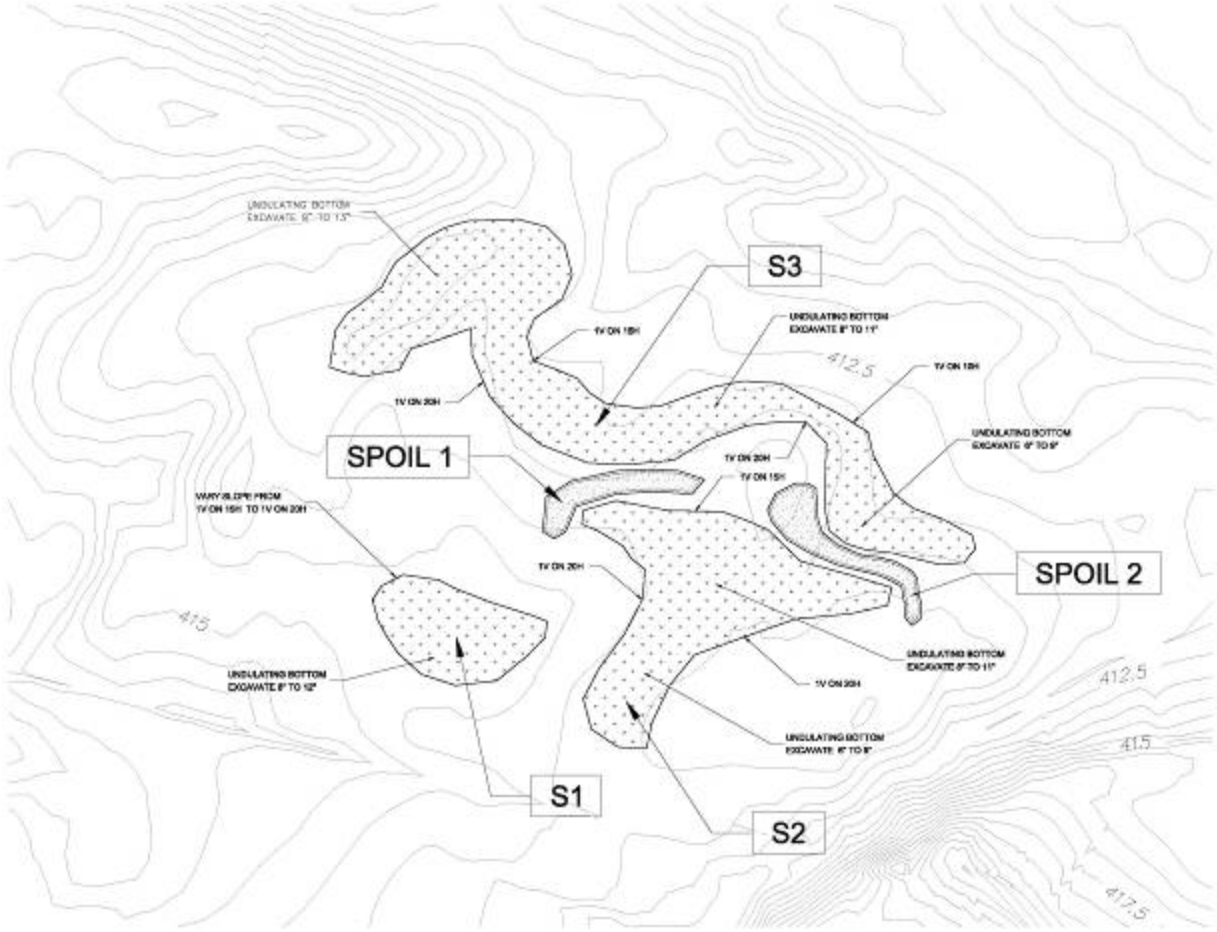
LOWER MISSISSIPPI RIVER BASIN
WEST CARUTHERSVILLE
WEST CARUTHERSVILLE, MISSOURI
ST. LOUIS DISTRICT

DEMPSEY FIRE AND RIFLE RANGE
KOW (ACRE), STATE, FARM
MISSISSIPPI RIVER AND RIFLE RANGE
MITIGATION PROJECT
DYRS

PLAN - POOL 2

M-LM-4/C-3

DRAWING NUMBER



PLAN - S1, S2, S3, SPOIL 1 & 2

SCALE: 1" = 100'

SHALLOW (S) EXCAVATION (8" TO 15")

US Army Corps of Engineers
ST. LOUIS DISTRICT

U.S. ARMY ENGINEER DIVISION
MISSISSIPPI VALLEY
ST. LOUIS, MISSOURI

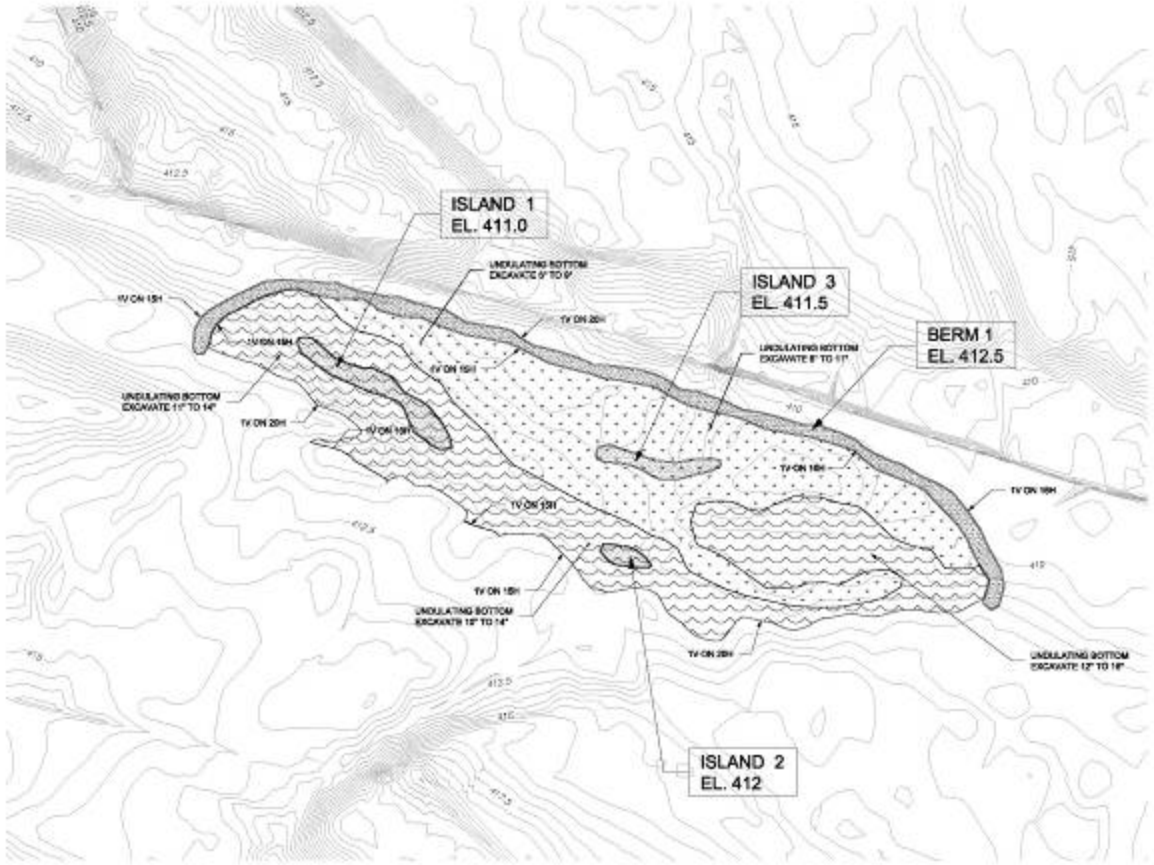
LOWER MISSISSIPPI RIVER BASIN
WEST ALTON, MISSOURI
ST. CHARLES COUNTY

DRAWING TITLE AND DATA (INCLUDES SCOPE, LOCATION, STATE, PARK, MISSISSIPPI RIVER BASIN AND MITIGATION PROJECT)
(SHT)

PLAN - S1, S2, S3, SPOIL 1 & 2

M-LM-4/C-4

DRAWING NUMBER



NOTES:
1. ALL BERMS WILL BE FIELD STAKED. CROWN WIDTH WILL VARY 20' TO 50'. SLOPES WILL VARY.
2. SLOPES ON ISLANDS WILL VARY FROM 1V ON 10H TO 1V ON 15H.

PLAN - POOL I

SCALE: 1" = 200'

SHALLOW (S) EXCAVATION (6" TO 15")

DEEP (D) EXCAVATION (14" TO 18")

US Army Corps of Engineers
ST. LOUIS DISTRICT

U.S. ARMY ENGINEER DIVISION
MISSISSIPPI VALLEY
ST. LOUIS, MISSOURI

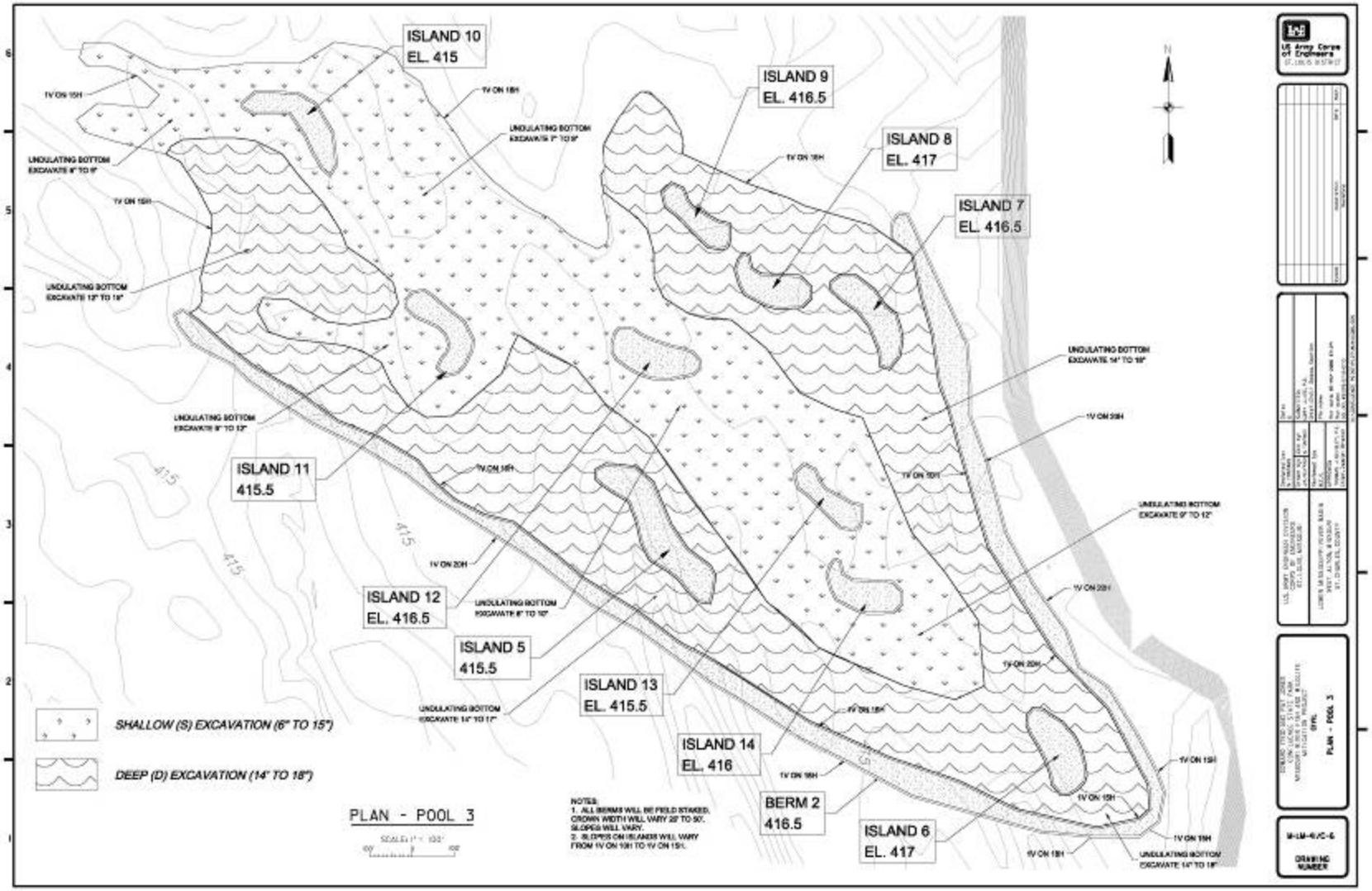
LOWER MISSISSIPPI RIVER BASIN
WEST BAY, LA. & MISS.
ST. CLAIR COUNTY, MISSOURI

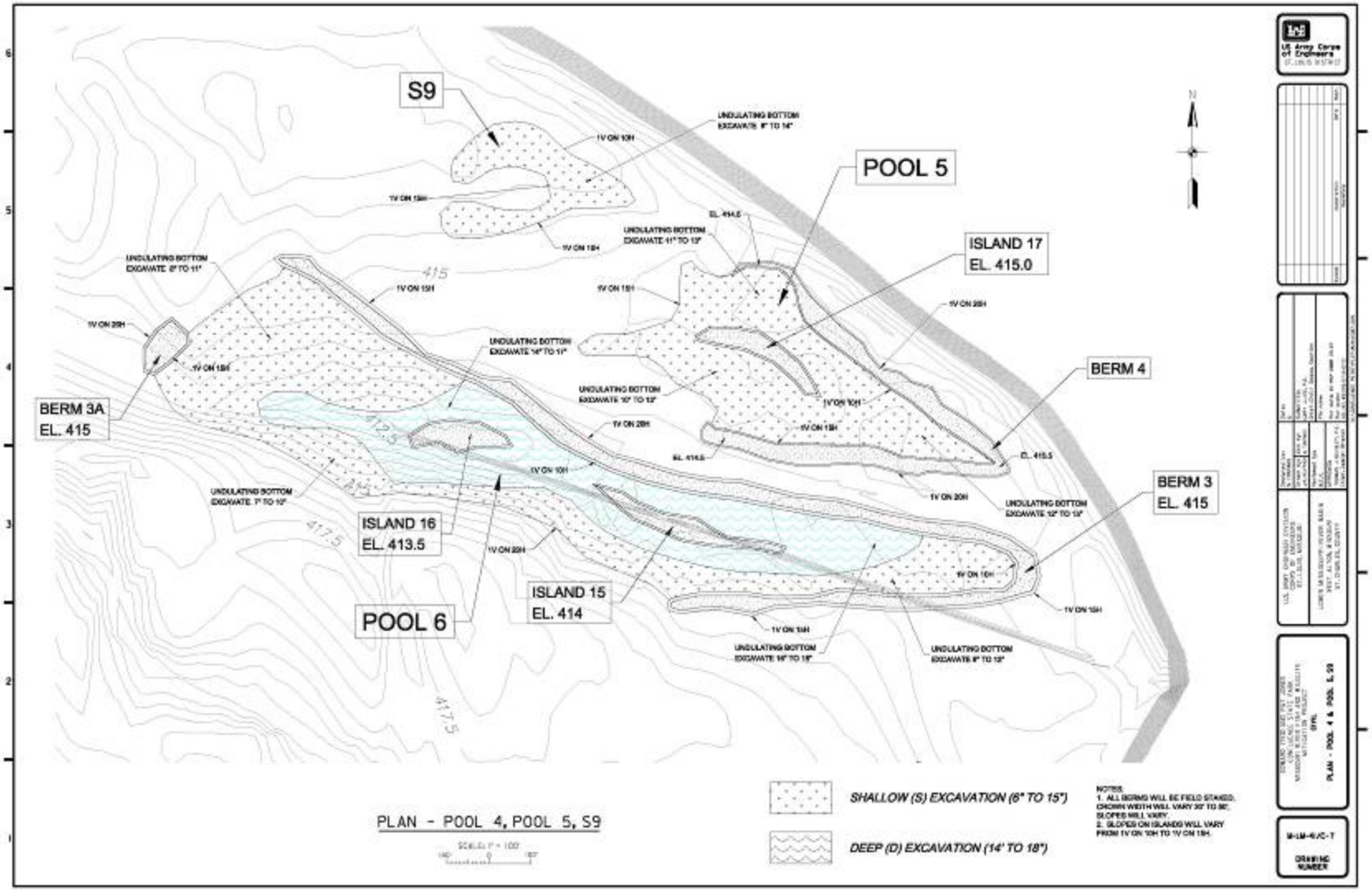
DRAWN FOR BID ON 1 JUNE
CONTRACTOR, STATE, FAX
MISSISSIPPI RIVER AND TRIBUTARIES
MITIGATION PROJECT
(BYS)

PLAN - POOL I

M-LM-4/C-5

DRAWING NUMBER


ISLAND 10
EL. 415
ISLAND 9
EL. 416.5
ISLAND 8
EL. 417
ISLAND 7
EL. 416.5
ISLAND 11
415.5
ISLAND 12
EL. 416.5
ISLAND 5
415.5
ISLAND 13
EL. 415.5
ISLAND 14
EL. 416
BERM 2
416.5
ISLAND 6
EL. 417
1V ON 15H
1V ON 18H
1V ON 20H
UNDULATING BOTTOM
EXCAVATE 8" TO 9"
UNDULATING BOTTOM
EXCAVATE 12" TO 14"
UNDULATING BOTTOM
EXCAVATE 8" TO 12"
UNDULATING BOTTOM
EXCAVATE 14" TO 18"
UNDULATING BOTTOM
EXCAVATE 9" TO 12"
415
SHALLOW (S) EXCAVATION (6" TO 15")
DEEP (D) EXCAVATION (14" TO 18")
PLAN - POOL 3
NOTES:
1. ALL BERMS WILL BE FIELD STAKED. CROWN WIDTH WILL VARY 20' TO 50'. SLOPES WILL VARY.
2. SLOPES ON ISLANDS WILL VARY FROM 1V ON 10H TO 1V ON 15H.
US Army Corps of Engineers
PLAN - POOL 3
M-LM-4/C-6
DRAWING NUMBER



PLAN - POOL 4, POOL 5, S9

SCALE: 1" = 100'

SHALLOW (S) EXCAVATION (6" TO 15")

DEEP (D) EXCAVATION (14' TO 18")

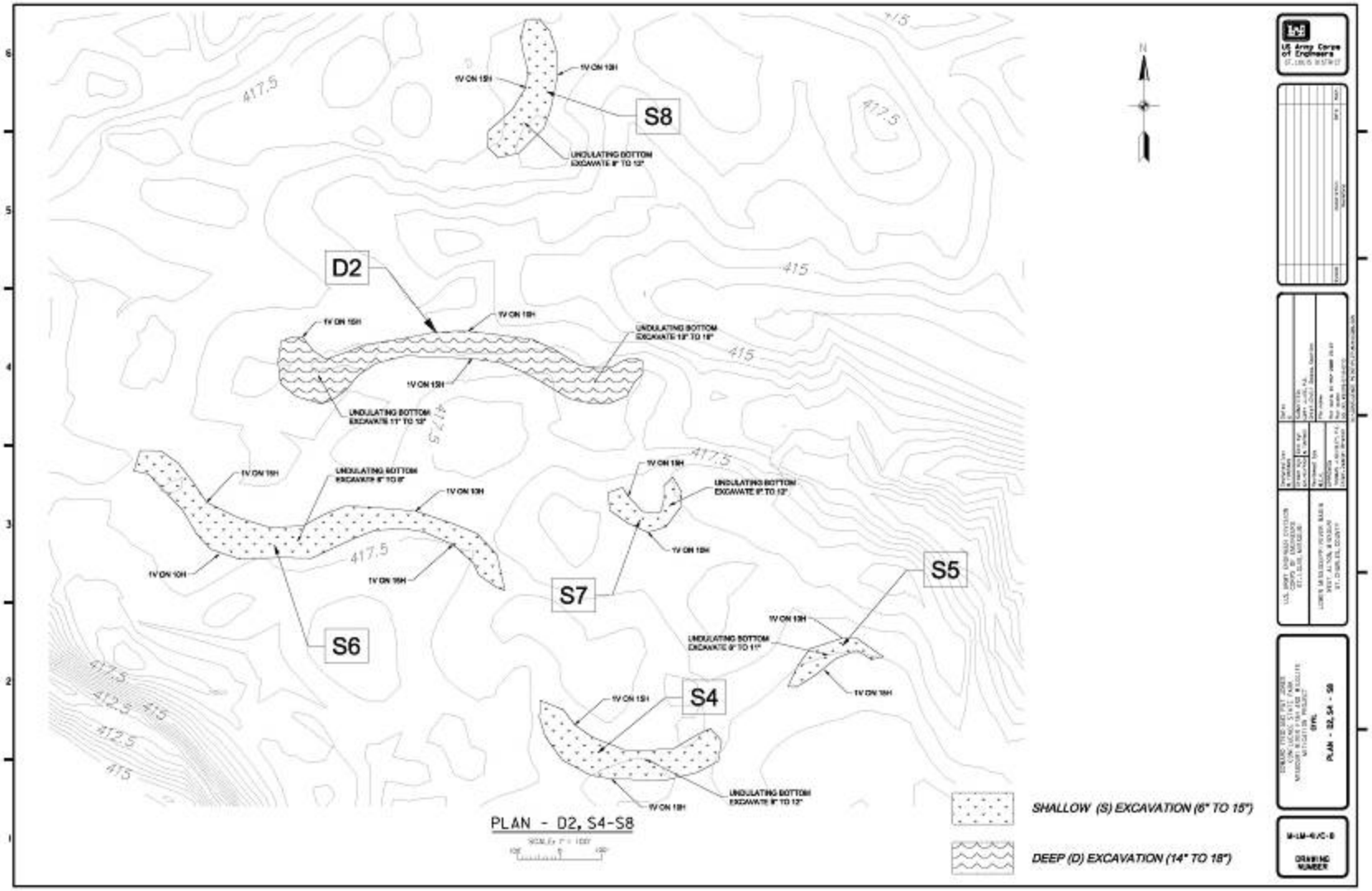
NOTES:
1. ALL BERMS WILL BE FIELD STAKED. CROWN WIDTH WILL VARY 20' TO 30'. SLOPES WILL VARY.
2. SLOPES ON ISLANDS WILL VARY FROM 1V ON 10H TO 1V ON 15H.

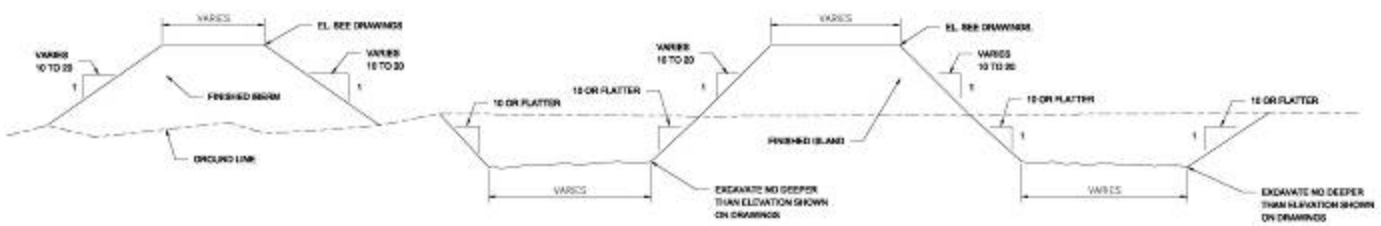
US Army Corps of Engineers
ST. LOUIS DISTRICT

PLAN - POOL 4 & POOL 5, S9

M-LM-4/C-7

DRAWING NUMBER


S8
D2
S7
S6
S5
S4
1V ON 15H
1V ON 10H
UNDULATING BOTTOM EXCAVATE 8" TO 12"
UNDULATING BOTTOM EXCAVATE 11" TO 12"
UNDULATING BOTTOM EXCAVATE 12" TO 18"
UNDULATING BOTTOM EXCAVATE 8" TO 9"
UNDULATING BOTTOM EXCAVATE 9" TO 11"
417.5
415
412.5
PLAN - D2, S4-S8
SHALLOW (S) EXCAVATION (6" TO 15")
DEEP (D) EXCAVATION (14" TO 18")
US Army Corps of Engineers
PLAN - D2, S4 - S8
M-LM-4/C-8
DRAWING NUMBER



BERM AND ISLAND WITH ADJACENT AREA

TYPICAL CROSS SECTION

NOT TO SCALE

US Army Corps of Engineers
ST. LOUIS DISTRICT

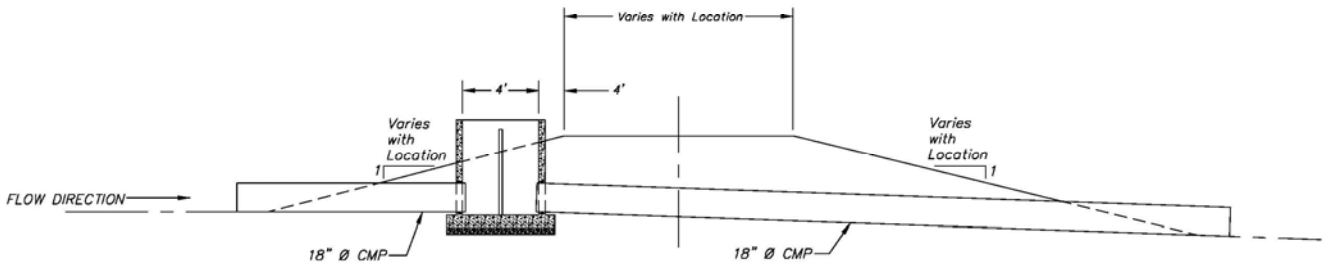
U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

LOWER MISSISSIPPI RIVER BASIN
WEST CARUTHERSVILLE
ST. CHARLES COUNTY

BERM AND ISLAND
WITH ADJACENT AREA
TYPICAL CROSS SECTION

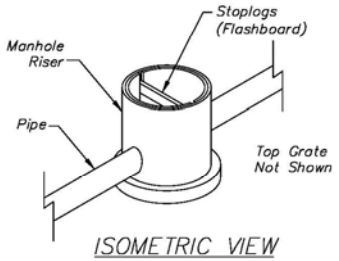
M-LM-4/C-9

DRAWING NUMBER



TYPICAL WATER CONTROL STRUCTURE
PROFILE VIEW

Not to Scale



ISOMETRIC VIEW
WATER CONTROL STRUCTURE

Notes:

1. The berm cross section shown shall be constructed for a distance of 25 feet to each side of the water control structure centerline.
2. Construct a smooth transition section between the water control structure berm cross section and the adjoining berm cross section.
3. The water control structure shall be a concrete in-line type stoplog structure.
4. The pipe shall be of the type and size specified on this drawing.
5. The pipe joints shall be watertight. Pipe shall be installed according to manufacturer's recommendations.
6. The water control structure shall be backfilled according to the drawings and specifications.
7. Excavate channels at the inlet and outlet as needed to provide drainage to and away from the water control structure.
8. Channels shall have minimum bottom widths of 4' with side slopes of 3:1 or flatter unless otherwise noted on the plans.
9. The pipe inlet and outlet and the stoplog riser shall each be marked with minimum 6' long steel fence post driven into the ground.

U.S. Army Corps of Engineers
ST. LOUIS DISTRICT

Symbol	Description	Date	Appr.

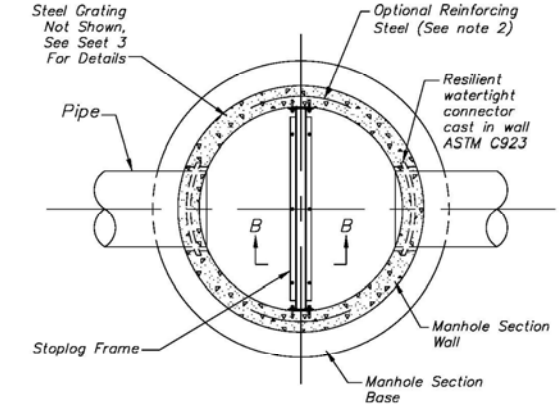
U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

LOWER MISSISSIPPI RIVER BASIN
WEST ALTON, MISSOURI
ST. CHARLES COUNTY

"DRAINAGE FIELD DITCH, CONTROL STRUCTURE, PIPE, MISSISSIPPI RIVER FISH AND WILDLIFE MITIGATION PROJECT"
STRUCTURAL
TYPICAL WATER CONTROL STRUCTURE
PROFILE VIEW
AND ISOMETRIC VIEW

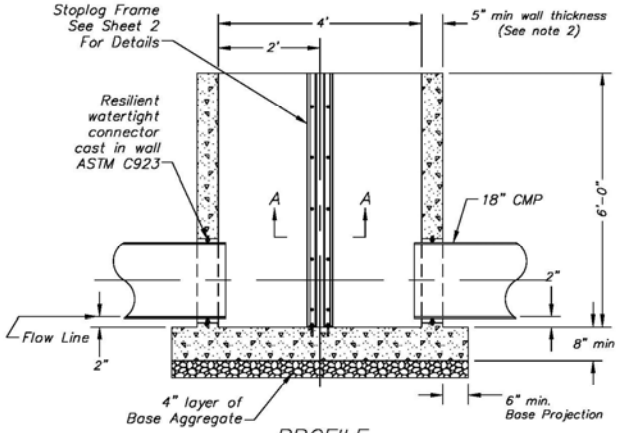
M-LM-415/S-1

DRAWING NUMBER



Note: Flap Gate Unit and Stoplogs not shown.

PLAN VIEW



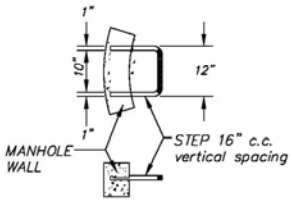
Not to Scale

PROFILE

Note:

Steps are to be installed in wall when manhole section height is 4 feet or taller.

Step dimensions shown are minimum acceptable dimensions.



POLYPROPYLENE STEP DETAIL

Notes:

1. All metal and fasteners shall be galvanized steel, stainless steel or aluminum.
2. Stoplog frame may be modified to be cast within the manhole floor and walls provided additional horizontal reinforcing steel is cast in the wall behind the frame. The steel reinforcement shall be 24" long #4 bars spaced on 12 inch centers with 2 inches of concrete cover from the the outside wall. The resulting slot shall have smooth faces and shall match the dimensions shown on this drawing. Stoplog lengths will be increased to 51 ½".
3. Stoplog widths may be less than 6" to provide desired water level. Stoplogs may be plastic or metal.
4. Install manhole section on a 4 inch thick layer of compacted base aggregate. Base aggregate shall be either MODOT Type 1 or Type 2.
5. See Drawing S – 3 for Section A–A and B–B.

U.S. Army Corps of Engineers
ST. LOUIS DISTRICT

U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

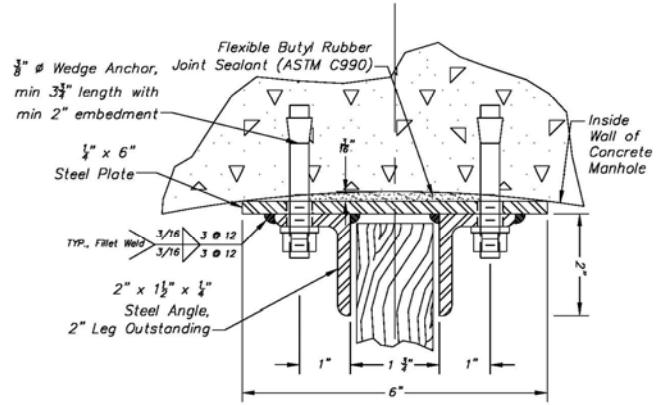
LOWER MISSISSIPPI RIVER BASIN
WEST ALTON, MISSOURI
ST. CHARLES COUNTY

"DRAINAGE DITCH AND FLAP GATES
CONTRACT NO. DACW43-01-C-0010
MISSOURI RIVER FDR AND R.O.D.F.E
WITH CONTRACT
STRUCTURE"

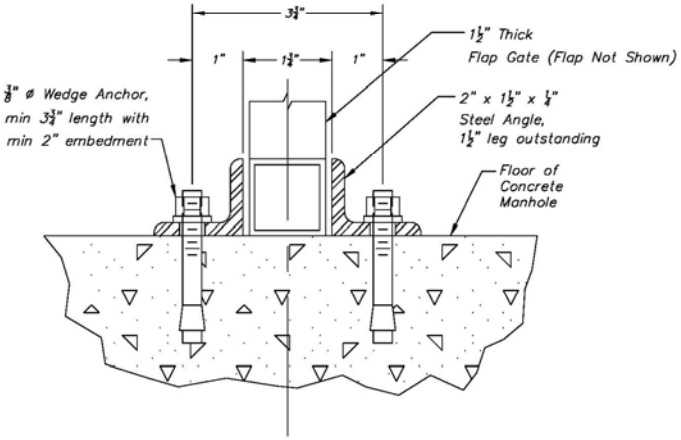
TYPICAL BAFFLE CONTROL STRUCTURE
PRECAST MANHOLE
PLAN, PROFILE AND DETAILS

M-LM-41/S-2

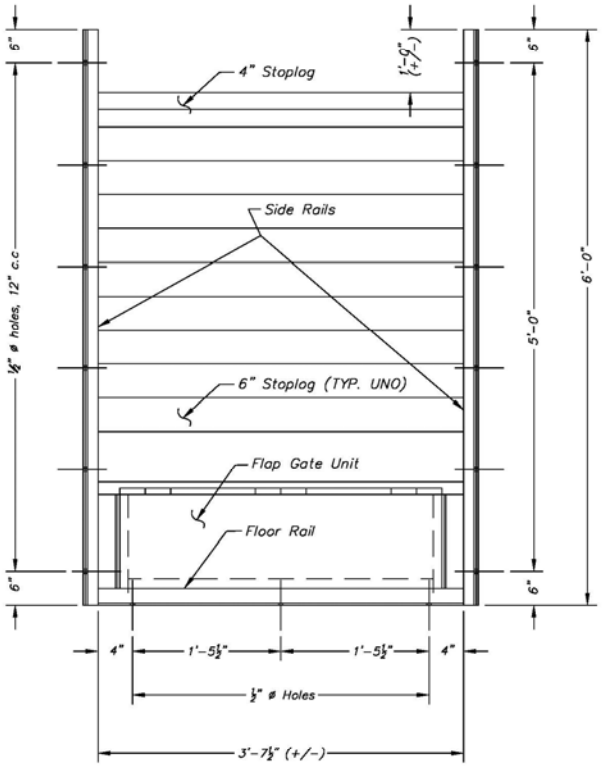
DRAWING NUMBER



SIDE RAIL
SECTION A–A



FLOOR RAIL
SECTION B–B



STOPLOG FRAME PROFILE

Notes:

1. Stoplog manufacturer's standard side and floor rail system may be used.
2. For flap gate unit details, see drawing S – 4.

Not to Scale

U.S. Army Corps of Engineers
ST. LOUIS DISTRICT

U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

LOWER MISSISSIPPI RIVER BASIN
WEST ALTON, MISSOURI
ST. CHARLES COUNTY

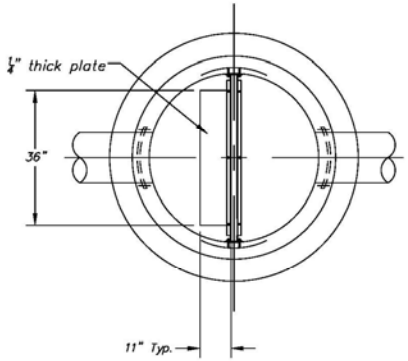
"DRAINAGE DITCH AND FLAP GATES
CONSTRUCTION, ST. CHARLES COUNTY
MISSOURI/RIVER FOX AND W.D.F.E
MITIGATION PROJECT"
STRUCTURAL
TYPICAL BAFFLE CONTROL STRUCTURE
STOPLOG PROFILE
AND RAIL SECTIONS

M-LM-41/S-3

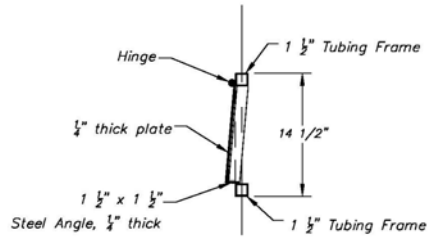
DRAWING NUMBER

Note:
1. All welds on steel structure shall be continuous for a watertight seal.

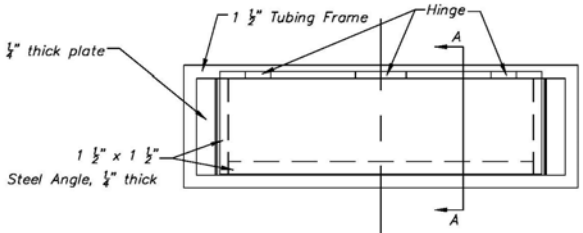
2. Hinge shall be fabricated and connected so that a watertight seal is achieved



Plan View WCS



Sec A–A



Profile View

INTERNAL FLAP GATE DETAILS

US Army Corps of Engineers
ST. LOUIS DISTRICT

Date	Revision Description	Sheet

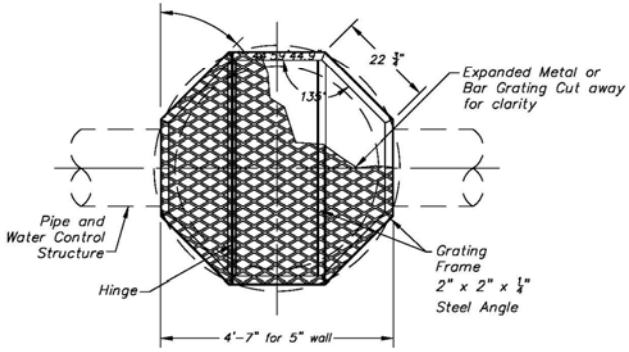
U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

LOWER MISSISSIPPI RIVER BASIN
WEST ALTON, MISSOURI
ST. CHARLES COUNTY

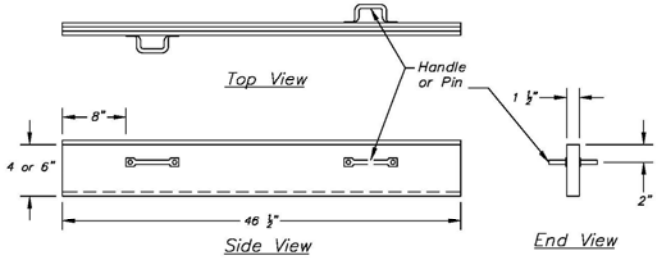
"DRAINAGE DITCH DIVERSION PROJECT"
CONTRACT NO. DACW43-01-C-0001
MISSOURI RIVER FEM AND W.O.F.E
WITCH CREEK PROJECT
STRUCTURAL
TYPICAL GATED CONTROL STRUCTURE
INTERNAL FLAP GATE
PROFILE AND SECTIONS

M-LM-41/S-4

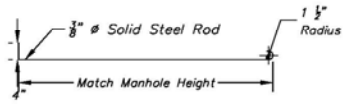
DRAWING NUMBER



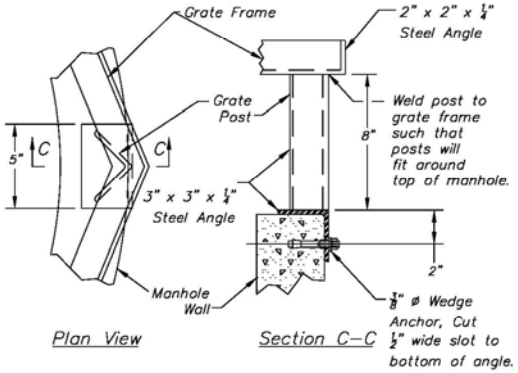
GRATING AND GRATE FRAME PLAN VIEW



STOPLOG DETAILS



LIFTING HOOK – (2 Required)



GRATE FRAME POST DETAIL

Notes:

1. All metal and fasteners shall be galvanized steel, stainless steel or aluminum.

2. The grate frame shall be secured to top of manhole section using ⅜" diameter wedge anchors.

3. Grating shall be secured to the grate frame. Grating shall have a hinge to obtain access to the stoplogs.

4. Grating shall be expanded metal or bar grating, capable of supporting a minimum load of 300 lbs. at center of a 4' span. Grating shall provide a means of accessing the stoplogs for removal while providing a platform from which to stand. Grating shall be lockable.

5. Stoplogs may be plastic or metal. Stoplogs shall be wedged in place if required to prevent flotation.

Not to Scale

U.S. Army Corps of Engineers ST. LOUIS DISTRICT

U.S. ARMY CORPS OF ENGINEERS ST. LOUIS, MISSOURI

LOWER MISSISSIPPI RIVER BASIN WEST ALTON, MISSOURI ST. CHARLES COUNTY

"CONSTRUCTION PLAN" FOR CONSTRUCTION OF THE FLOOD MISSOURI RIVER FOR AND W.O.F.E WITH ST. LOUIS DISTRICT STRUCTURES

TYPICAL WATER CONTROL STRUCTURE GRATING PLANS AND DETAILS AND STOPLOG DETAILS

M-LM-41/3-5

DRAWING NUMBER

Appendix C
Cultural Resources

DRAFT

Magnetometer Survey for buried steamboats Near the mouth of the Missouri River

Timothy H. Larson
Illinois State Geological Survey

August 2, 2007

INTRODUCTION

> "…piloting becomes another matter when you apply it to vast streams like the Mississippi and the Missouri, whose alluvial banks cave and change constantly, whose snags are always hunting up new quarters, whose sand-bars are never at rest, whose channels are forever dodging and shirking, and whose obstructions must be confronted in all nights and all weathers without the aid of a single lighthouse or a single buoy…"
> Mark Twain, *Life on the Mississippi*

In a day when even a weekend fisherman has access to high resolution GPS positioning and sophisticated sonar navigation and several government agencies are diligently maintaining channels and navigational aids it is hard to imagine that a century and a half ago literally hundreds of vessels were lost to the Mississippi' and Missouri's dodging and shirking channels. Furthermore, some of the channels have shifted to such a degree that some of the wrecks are now buried below corn and soy bean fields. In particular, this study is designed to search for four wreck sites near the mouth of the Missouri: two at Mobile Island and two on the Cora Island Chute. Mobile Island, once truly an island at the confluence of the Missouri and Mississippi is now only slightly higher ground amidst the corn fields. Cora Island Chute is mostly a swamp with seasonal flooding contained by a large agricultural levee (Figure 1).

The Bedford, an 82-ton side-wheeler, was built in Cincinnati in 1839 (Lytle, 1952). On the evening of the 25th of April 1840 she was descending the Missouri River near its mouth, bound for St Louis, when she struck a snag and sunk in less than 5 minutes in deep water (Lloyd, 1856). Two possible locations for this wreck have been reported, one on the south side of Mobile Island, the other at the east end of Cora Island Chute. The Edna, a 183-ton side-wheeler, steamed out of Louisville in 1842 (Lytle, 1952). She exploded on July 3, 1842 at the mouth of the Missouri River. Fifty passengers died (Lloyd, 1856). The site has been reported on the north side of Mobile Island. The much larger Argonaut (229 tons) was a stern-wheeler from Pennsylvania. Built in 1855, she was lost near the mouth of the Missouri in 1863 (Lytle, 1952). The site of this wreck has been reported to be in the Cora Island Chute. Assuming that the mechanical equipment of the Bedford and Argonaut have remained more or less intact, they should include a boiler, engine, stacks, and connecting piping of several tons of iron. The ships themselves were approximately 100 ft by 40 ft and if intact, are now likely buried about 40 ft below the land surface.

According to Breiner (1996), a one-ton iron object at a distance of 30 ft should produce a magnetic anomaly on the order of 40 gammas (gamma is a measure of magnetic field where 1 gamma is equivalent to 1 nanoTesla, the standard unit of measure). When using feet for distance and the approximation that 1 ton of iron has the magnetization of 1×10^6 then we can estimate the magnetic signature from the formula:

$$\mathbf{T} = \mathbf{M}/\mathbf{r}^3$$

Where **T** is in gammas
M is magnetization
r is distance from magnetometer (in feet)

Size (tons)	**Distance** (ft)	**anomaly** (gamma)
1	30	40
1	60	4.6
1	90	1.4
2	30	74
2	60	9
2	90	2.7
4	30	148
4	60	18
4	90	5.5

On the basis of these estimates, a magnetometer survey with a 60-ft transect spacing should reveal a magnetic anomaly associated with an intact, buried steamboat. Even assuming a burial depth of 40 ft and an offset of 60 ft, the anomaly associated with a 1 or 2 ton object would be 5 to 10 gamma. For this survey, the magnetic sensor was mounted 7 ft above the ground surface to avoid signals from small, surficial magnetic objects. Also, because this survey was intended to locate large, distinct objects, no explicit provision was made to account for diurnal fluctuations of the magnetic field during the survey. The parameters for a primary magnetometer search include a magnetometer with sensitivity of 1 gamma, survey location accuracy of 3 ft (1 m) and search lines separated by 60 ft. To meet these parameters we used a Geometrics G 858 Cesium-vapor magnetometer (<0.01 gamma sensitivity) integrated with a Trimble AG114 DGPS location and guidance system (+/- 1 m RMS horizontal accuracy) both magnetic value and position recorded at 1 second intervals along the traverses. The magnetometer and GPS system were mounted on an aluminum backpack with the GPS antenna at 6 ft and the magnetometer sensor at 7 ft above ground (figure 2).

Approximately 370 acres were searched in two areas during the four day survey between June 11 and 14, 2007. The two main search areas were based on accessible land surrounding the 2 reported locations of the Bedford and the single reported locations of the Edna and Argonaut. These areas are the Cora Island Chute area (Bedford I and Argonaut) and the Mobile Island area (Bedford II and Edna).

PRIMARY SEARCH

Cora Island Chute search area

The Cora Island Chute survey covered about 100 acres in two patches on June 14, 2007. The second patch overlapped with an extension of the initial data transect from the first patch allowing the two data sub-sets to be tied together through a simple linear time-based correction of the entire data set. The eastern patch was acquired in corn and soybean fields and followed the existing northeast-southwest trend of the fields. The south boundary of the survey area is the agricultural levee at the north edge of Cora Island Chute. Several transects of the eastern patch crossed the levee to the wooded area just south of it. The east boundary of the survey area is an access road. A large magnetic anomaly on the east margin is caused by a parked vehicle. The west edge of the eastern patch is defined by a large wooded area surrounding a water-filled swale. Two transects were acquired in the space between the levee and the wooded area to connect the eastern patch with the western patch. The west side of the wooded area is the eastern margin of the west survey patch. Newly germinated soybeans were growing in this area. Transects in this patch were oriented with the north-south trending edge of the woods. A water-filled swale extends north-west beyond the woods into the west part of this data patch. Also, an east-west oriented drainage ditch extends west from the woods into this area. Several large pieces of debris, including at least one vehicle, were observed within the wooded area. Dense vegetation and water blocked further access to the woods.

The reported location of the Argonaut wreck is in the inaccessible area of the Cora Island Chute, south of the search area. Visual inspection of the area indicates the wreck area is densely vegetated swamp and water. Land-based surveys are not likely to be possible at any time of year. The Argonaut was a large vessel and if still intact may present a reasonable target for an air survey. The first reported location of the Bedford wreck (Bedford I) is near the east junction of the levee and the woods. Although the field east of this location was searched, the woods blocked a complete search immediately west of the reported location.

Figure 3 depicts the GPS locations of the survey points and the contoured total magnetic field in the Cora Island Chute area. Despite the linear data correction, a gradual northward increase is apparent in the magnetic data, especially east of the woods. A color-image underlay of the data illustrates this subtle variation which may be related to non-linear temporal variations in the magnetic field or to changes in soil or geology. No attempt was made to remove this magnetic gradient as it is not relevant to our search. Minor magnetic anomalies are associated with the levee on the south margin of the survey area. One transect and a transect cross-line detected a strong localized magnetic anomaly at the toe of the levee where it meets the wooded area. This magnetic anomaly appears to be caused by a relatively shallow (about 6 ft) buried metal object, perhaps associated with the levee. Although this magnetic anomaly is very close to the reported location of the Bedford I site, and the search may not have completely defined the magnetic anomaly, it is too small in size and too shallow in origin to be caused by the Bedford. Similarly, an even more localized magnetic anomaly south of the woods is likely caused by a small un-observed piece of metal. Several other magnetic anomalies along the northwest boundary of the search area are caused by either debris in the wooded area or field drains which

empty into this swale. No other significant magnetic anomalies which could be associated with buried shipwrecks were observed in the Cora Island Chute area.

Mobile Island search area

The Mobile Island survey covered approximately 270 acres and was acquired as six overlapping patches during June 11-13. Land-cover included full-grown corn, young and newly planted beans, un-planted agricultural land, and prairie grass and cottonwood saplings in areas that had been removed from cultivation. Recent flooding had left large areas covered with water and thick mud. This survey area encompassed a reported location of the Bedford in the southeast part and the reported location of the Edna in the northwest part. Both the east and west boundaries of the search area were arbitrarily set to include these two reported locations. The north boundary of the search area was a field access road that approximately coincides with a major underground pipeline. The southeast boundary of the search area is a corridor of pipelines and overhead power lines. The southwest boundary is a tree-lined, water-filled slough. The search area describes three-quarters of a large rectangle. The southwest quadrant was left un-explored as it was furthest from any reported shipwreck locations. The traverse lines followed the trend of the access roads and field lines, with an orientation slightly north of west. All lines were spaced at nominal 60 ft intervals.

Figure 4 depicts the GPS locations for the survey points and the contoured total magnetic field. Roads and water bodies are included for reference. Small, constant offsets were added to the observed magnetic values, patch-by-patch, to align them at points of overlap. In this way, a single map of magnetic field was created from the individual data sets. Identifiable magnetic anomalies are labeled on the figure. These are associated with buried pipelines, signs and gates along the roads, surface debris, a parked car, and drainage tiles or culverts. A linear feature near, but not part of a pipeline at 749,100 m E and 4,302,400 m N is unidentified.

It is unknown whether the remnants of the Edna's boilers were dispersed following her catastrophic explosion or if they were contained within the hull of the ship. Presumably their disposition would affect the intensity of a magnetic anomaly. The reported location of the Edna wreck is near a water-filled swale in the northwest quadrant of the Mobile Island search area (figure 5). The magnetic survey came as close to the edge of the water as possible, but some parts of this area were not searched. No unexplained magnetic anomalies were detected in the searched areas near the reported location. A buried pipeline crosses the north margin of the study area. At least 2 linear magnetic anomalies in a swale north of the water-filled swale are difficult to interpret because they merge with, and may be associated with the magnetic anomaly caused by the pipeline. A similar linear magnetic anomaly appears on the southwest margin of this quadrant as the marginal transects approach another pipeline. A localized, strongly negative anomaly was detected along a tree line at the southwest edge of the search area. Although no metal objects were observed, this anomaly is likely caused by a piece of metal at or near the ground surface.

A large, unidentified magnetic anomaly was detected at 749340 m East, 4302060 m North, within 100 m of the second reported location of the Bedford wreck. This magnetic anomaly is at least 45 gamma in amplitude and was detected on 3 traverse lines. A smaller

negative lobe to the northwest indicates that this magnetic anomaly is caused by a buried dipolar magnetic object. The magnetic anomaly is situated at the east edge of a long, shallow swale. The magnitude and areal extent is consistent with a large – 1 ton or larger- iron object buried several tens of feet below the ground. Given the proximity of this magnetic anomaly to the reported location of the Bedford wreck, its isolation from cultural features, its situation at the edge of a swale and its magnitude and extent, further investigation is warranted.

DETAILED SEARCH FOR BEDFORD

Based on positive results of the preliminary analysis of the Mobile Island survey, a detailed survey of the magnetic anomaly in the southern part of the Mobile Island area was acquired on June 15, 2007. The 100 m by 125 m survey area is north of a small hill and east of the main park road. An access road crosses the southeast part of the survey area. The ridge and swale landscape had been out of agricultural production for several years. The ridges were thickly covered with young cottonwood saplings and swales with prairie grasses and thistles (figure 6). Nominal 15-ft line spacings on north-south traverses were maintained with the DGPS guidance system. Actual locations were integrated into the magnetic data set at 1.0 second intervals. Total-field magnetic values were recorded every 0.2 seconds. The data were processed with a de-stripe filter to align the alternating north and south traverse lines. A single-value (53,120 nT) representative of the earth's main magnetic field was subtracted from each magnetic data value. To further enhance the image, a reduction-to-pole (RTP) correction was applied to the data (Fig 7). This correction compensates for the geometrical effects of the earth's magnetic field and reorients the data to align with the north magnetic pole. The result is the true shape of the magnetic anomaly due solely to the buried object.

The gridded RTP data were analyzed in several ways. Qualitatively, the main magnetic anomaly is similar to the one obtained by the larger Mobile Island survey. Several smaller magnetic anomalies are also present in the southern part of the survey area at the base of the small hill. Another magnetic anomaly occurs where the road crosses the survey area and could be a culvert or drain beneath the road. The main magnetic anomaly has a maximum amplitude of 102 nT (or gammas). Using the transect through this maximum (figure 8), the "half-width approximation" (Breiner, 1996) yields a depth of 13 m below the sensor. Assuming the buried object is iron (and a magnetic field strength of 1×10^6 per ton of iron) then its approximate mass is 7.9 tons. Gridded anomaly data were analyzed further using an inversion program (Tchernychev, 2004). This program tries to find the best match between calculated spherical dipole sources and the observed data. Without more specific information on the shape, magnetic susceptibility and remanent magnetism of the source the result can only approximate the true source object. Despite these limitations, the results are informative. The program converges to a solution of:

Location: 749,334.3 m East, 4,302,068 m North
Depth: 13.5-13.7 m (44.3-45 ft below sensor, 37.3 to 38 ft below ground)
Mass: 8500 to 1100 kg (where 1000 kg = 1 ton)
Magnetic strength: 1.46×10^6 to 1.5×10^6 (where iron is approximately 1×10^6)

These values are similar to other approximations of the source size and depth. The inversion explicitly assumes a spherical source object. The estimated mass of the source object – 8 to 10 tons of iron, is 10 percent of the listed displacement of the Bedford. It is hard to estimate what portion of the ship was iron. It is also difficult to estimate the magnetic effects of these various parts in a non-spherical distribution. However, the general size, location, and depth, based on independent methods are all consistent with the wreckage of the Bedford as a source for this magnetic anomaly.

A series of smaller magnetic anomalies occur at the base of the hill in the southern part of the survey area. Magnetic inversions of several of these magnetic anomalies consistently result in source depths of 4 to 4.5 m below the sensor (approximately 6 ft below ground). These magnetic anomalies are separate from the main magnetic anomaly and have much shallower sources. They are not likely caused by parts of the Bedford shipwreck.

SUMMARY

This magnetic survey searched the accessible area around four reported locations of steamship wrecks. The area immediately around the reported location of the Argonaut wreck was not accessible to this search. The hundred-acre search nearest to this site and to one reported location of the Bedford wreck did not result in any magnetic anomalies that could be attributed to these sunken ships. A large wooded area and swampy ground within the Cora Island Chute area blocked access to significant parts of this search area. The steamship Edna exploded and sank. It is not clear what type of magnetic signature the remains of this ship would produce, however, no significant magnetic anomalies were found in the search area that could be attributed to the Edna. Some of the search area near the reported location of the Edna was covered with water and could not be searched. A large magnetic anomaly, probably caused by an 8 to 10 ton iron object buried 35 to 40 ft below ground was detected within 100 m of the second reported location of the Bedford wreck in the Mobile Island search area. The size and strength of this magnetic anomaly, and its location at the edge of a swale near the reported location of the Bedford suggest that this may be caused by parts of the wreck from the Bedford. The source of this anomaly is located at UTM coordinates: 749,334 m East, 4,302,068 m North. Further investigation of the site of this magnetic anomaly is recommended.

REFERENCES

Breiner, Sheldon, 1999. "Applications manual for portable magnetometers", Geometrics, Inc, San Jose, CA, 58 p.

Lloyd, James T., 1856. "Lloyd's Steamboat Directory and Disasters on the Western Rivers", James T. Lloyd and Company, Cincinnati, Ohio, 326 p.

Lytle, William, M, 1952. "Merchant Steam Vessels of the United States: 1807-1868". Publication No. 6, Steamship Historical Society of America, Mystic, Connecticut.

Tchernychev, Mikhail, 2004. "MAGPICK-magnetic map and profile processing User Guide", Geometrics, Inc, San Jose, CA, 98 p.

FIGURES

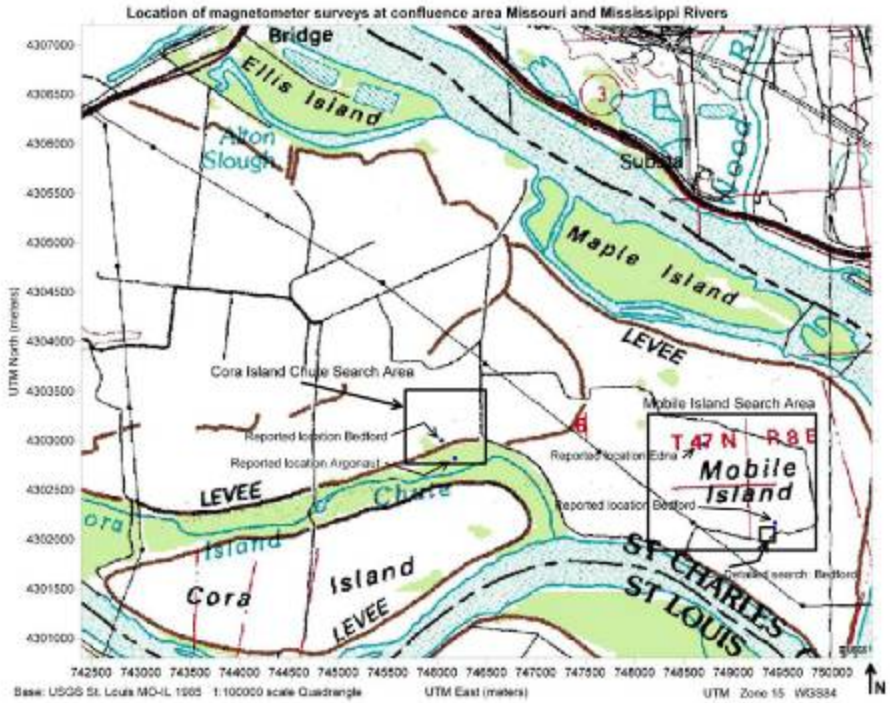


Figure 1. Location of magnetic survey search areas in the Missouri/Mississippi confluence area.

Figure 2. Two views of the magnetometer and GPS backpack. Magnetometer sensor is the higher white cylinder, the GPS antenna is the white dome with yellow band. A blue metal arm holds the GPS guidance display unit and a small data-logger is carried around the waist.

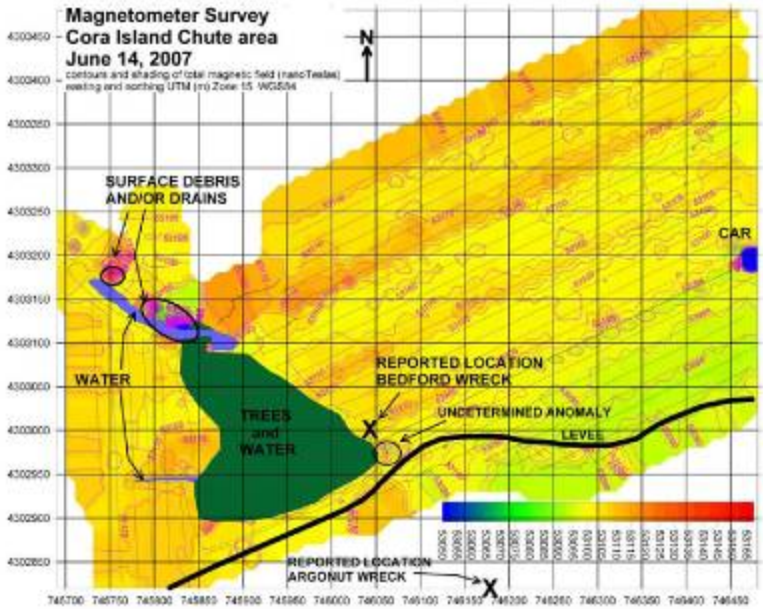


Figure 3. Results of the Cora Island Chute magnetic search.

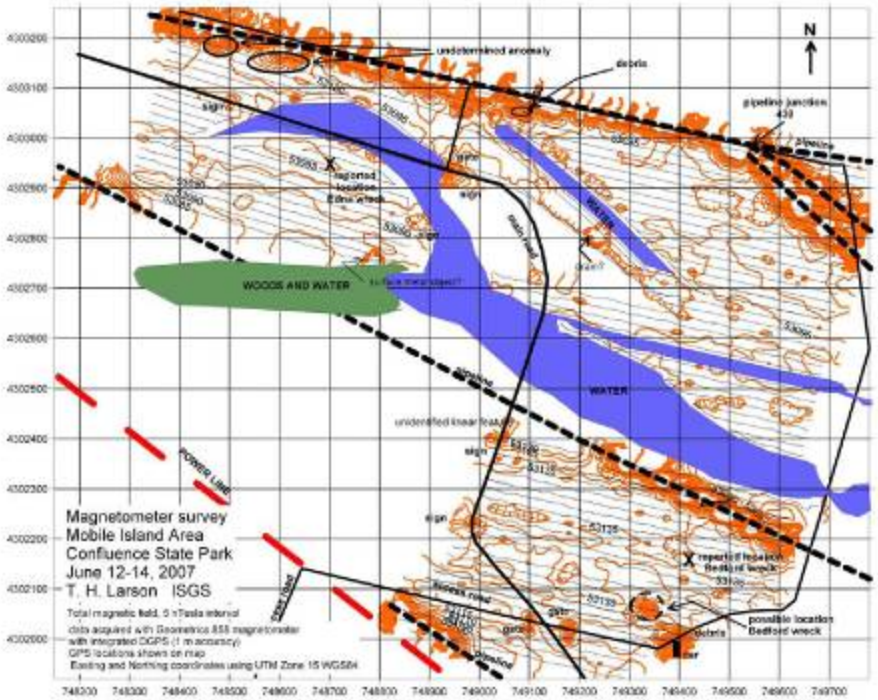


Figure 4. Results of Mobile Island magnetic search.

Figure 5. Water-filled swale in Mobile Island search area. View from park road looking southeast. Reported location of Edna wreck is on the far side of water. Search area extended to trees in background.

Figure 6. Two views of the southeast part of the Mobile Island search area. Left: looking to the northwest from a low hill at edge of survey area. Trees at far left background are same as those shown in Figure 6. Right: view from inside brushy area. Edge of swale (right) is marked by transition from grasses to trees. This is area of large magnetic anomaly possibly caused by Bedford wreck.

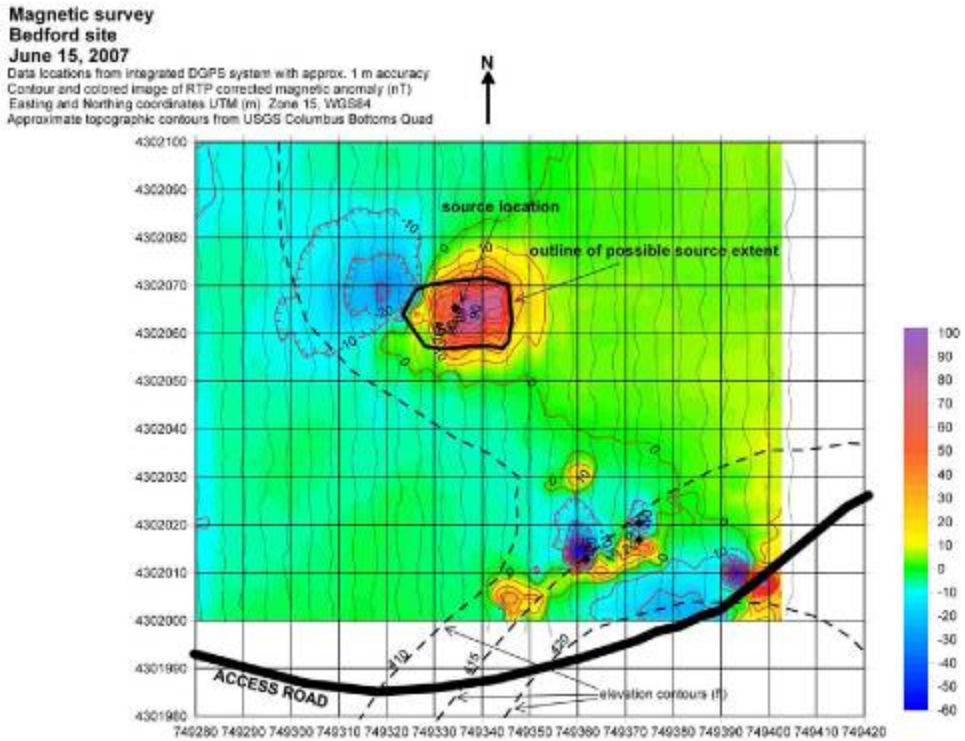


Figure 7. Results of detailed magnetometer search in southeast part of Mobile Island area. Both contours and colored image maps depict the reduced-to-pole magnetic anomaly. Elevation contours were sketched from USGS 7.5 minute Columbia Bottoms Quad.

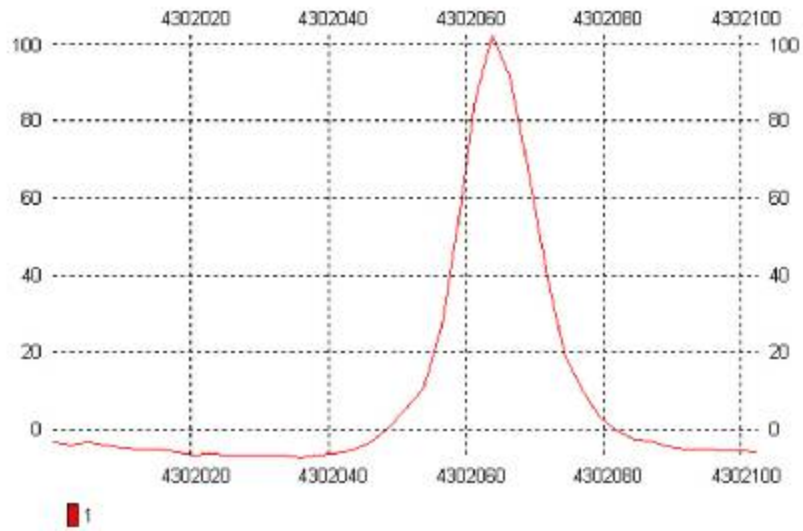


Figure 8. A single south-north magnetic profile from the detailed magnetic search. Reduction to Pole correction has been applied to this data. Y-axis is magnetic anomaly in gammas. X-axis is UTM northing location in meters. This profile is along easting coordinate: UTM 749, 235 m East.

Appendix D
Baseline Habitat Assessment

DRAFT

Introduction

The Confluence Point State Park Site (CPSP) is comprised of a 532-acre Northern tract owned by U.S. Army Corps of Engineers (USACE) and a 586-acre Southern tract owned by Missouri Department of Natural Resources (MDNR) totaling 1,118 total acres. USACE purchased its portion from the Confluence Greenway in 2007. An existing agreement allows a neighboring farmer to continue farming the Northern tract until the project is ready to be constructed. Existing habitat components include agricultural fields, early successional fields and grasslands, seasonally flooded wetlands, and a narrow band of riparian forest outside of the levee. The Kuhs Federal levee currently protects land on the floodplain. Management responsibilities for the entire site are contracted to MDNR under a Cooperative Agreement.

Methods

Methodology used to evaluate baseline (pre-project) habitat conditions for the year 2006 follows the guidance established in the Missouri River Fish and Wildlife Mitigation Program Draft Monitoring and Evaluation Plan (Corps, 2004). The methodology generally consists of a desktop photo interpretation evaluation using aerial photography (or infrared photography if available) from specific years (or best available data) and classifying the habitat types on the CPSP using the National Wetland Inventory (NWI) and National Land Cover Data (NLCD) classification systems. This methodology relies on skills to photo interpret imagery and on knowledge of land use types and land management typical of the region and on the CPSP. Pre-project conditions were evaluated by using 2006 color aerial photography data, U.S. Geological Survey Long Term Resource Monitoring Program land cover data from the year 2000, as well as site visits and interviews from site managers and the farmer still utilizing the land. The 2006 aerial photography consisted of aerial photos taken in summer conditions. The summer photography was flown by USDA for crop compliance purposes.

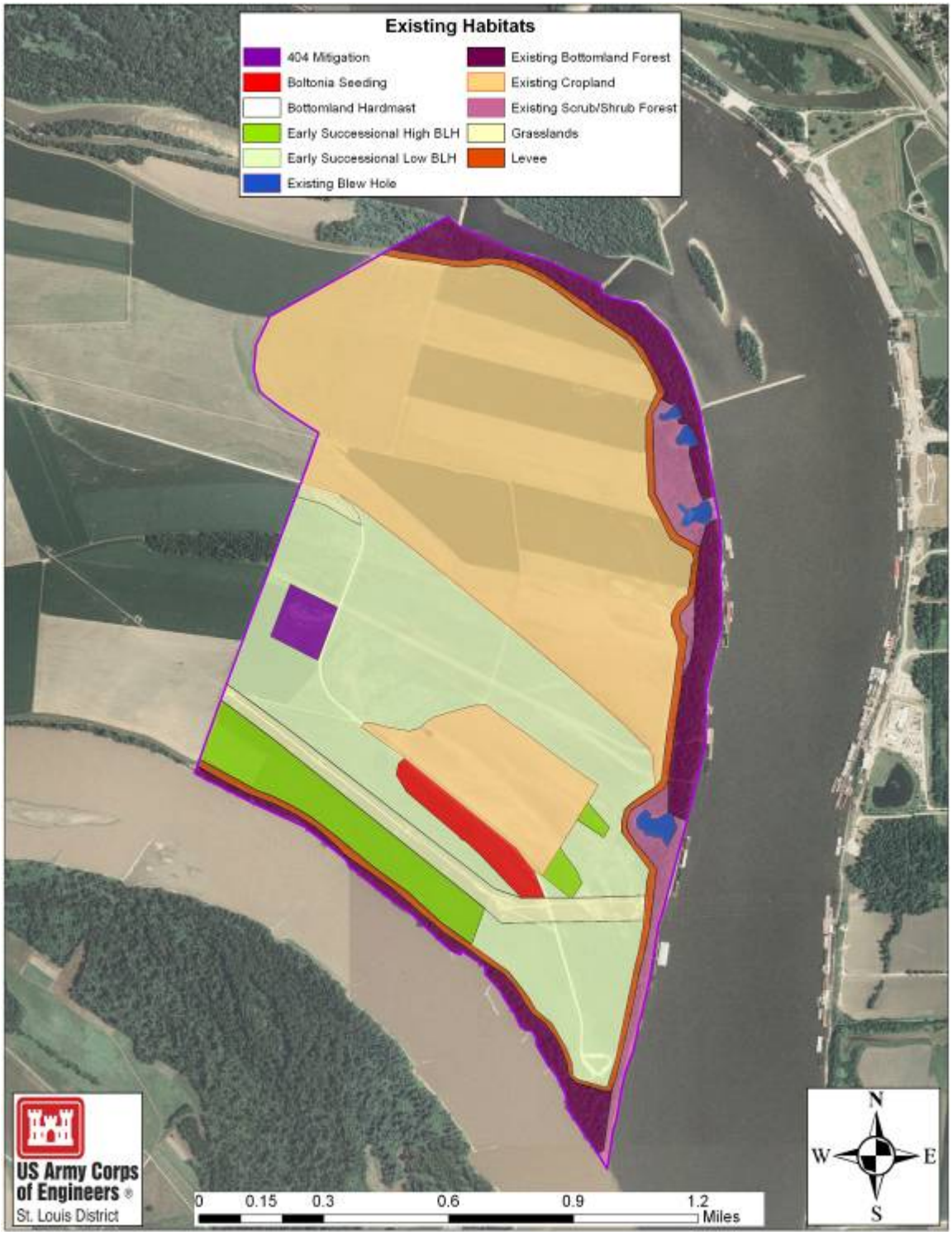
Results

The baseline habitat conditions are found in Table 1 below and figure 1.

Table 1: Baseline Terrestrial and Aquatic Habitat Conditions at the Confluence Point State Park Site

General Habitat Type	Existing Acres
Wet Prairie/Grassland	41.3
Boltonia Restoration	18.2
Sandbar/Mudflat	0
Scrub/Shrub	0
Wet Bottomland Forest (Low)	306.6
Wet Bottomland Forest (High)	58.0
Wet-Mesic Forest	0
Deep Meander	0
Deep Pool	0
Shallow Meander	0
Shallow Pool	0
Shallow Scour	0
Spoil Banks	0
Mounds	0
Crops/Agriculture	511.9
Existing 404 Wetland	11.2
Existing Bottomland Forest	88.5
Existing Scrub/Shrub	36.5
Levee	38.9
Existing Blew Hole	7.5
TOTAL	1118.6

Figure 1: Baseline Terrestrial Habitat and Aquatic Conditions at the Confluence Point State Park Site



Appendix E
Biological Assessment

Biological Assessment

Introduction

Under provisions of the Endangered Species Act of 1973 (16 U.S.C. Section 1531 et seq., as amended), Federal agencies are directed to conserve threatened and endangered species and the habitats in which these species are found. Federal agencies are required to ensure actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of threatened and endangered (T&E) species or their critical habitat. This Biological Assessment (BA) provides documentation to meet Federal requirements for the proposed action. This BA only addresses Federally listed T&E species.

The proposed Confluence Point State Park Site is considered a construction activity thus a BA must be prepared to address potential impacts to Federally listed or proposed T&E species. This BA has been prepared in accordance with Section 7 of the Endangered Species Act and in accordance with the 1998 procedures set forth by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service.

Purpose and Need

The purpose of the Missouri River Fish and Wildlife Mitigation Program (Mitigation Program), and site-specific projects, is to mitigate the loss of fish and wildlife habitat due to the Missouri River Bank Stabilization and Navigation Project (BSNP). The Rivers and Harbors Act of 1912, 1925, 1927, and 1945 authorized the BSNP. The existing BSNP extends 735 miles from Sioux City, Iowa to the mouth near St. Louis, Missouri and maintains a nine-foot deep by 300-foot wide channel. The BSNP consists mainly of revetments along the outsides of bends and transverse dikes along the insides of bends to force the river into a single active channel that is self-maintaining. The need for the Mitigation Program, and site-specific projects, rests in the loss of a unique floodplain ecosystem including diverse fish and wildlife habitat and species, and the changing public values that have placed significant importance on fish and wildlife species and ecological resources. The historic variety and quality of aquatic habitats have been eliminated or altered by construction of the navigation channel. Dikes and revetments have greatly reduced the meandering and flooding of the river and thus have allowed for land clearing and expansion of agricultural practices into the historic floodplain. The Corps estimated that by 2003, approximately 522,000 acres of fish and wildlife habitat in the natural channel and meander belt of the Missouri River would be lost as a result of the construction, operation, and maintenance of the BSNP.

Habitat loss and resultant adverse impacts to fish and wildlife resources need to be mitigated as authorized by the U.S. Congress through the Water Resources Development Acts of 1986 and 1999. Acquisition and development of lands along the Missouri River need to occur to adequately mitigate the resources lost to channelization and bank stabilization.

To achieve the objective of the Mitigation Program, public and non-public lands suitable for developing, restoring, and preserving aquatic and terrestrial habitats were identified. One site identified for acquisition and habitat development was the Confluence Point Site. Development of this site for fish and wildlife habitat would contribute to achieving the goals and purpose of the Mitigation Program to mitigate for the loss of habitat that resulted from the BSNP.

Project Description

Confluence Point spans the distance between the main channels of the Missouri and Mississippi rivers at their junction. Its terrain is characterized by a ridge and swale topography that shows the pattern of flooding and drainage that generally flows from west to east. Total relief is approximately twelve feet with elevations ranging from 408 to 421 feet above sea level. A natural levee has developed along the Missouri River, and two other isolated terraces or high spots are situated internally. Soils at Confluence Point all formed from recent alluvial deposits. They are low in elevation and are frequently flooded with ground water that fluctuates with river levels. A relatively large and level "plain" at the 416-417 foot elevation covers the northwest park quadrant. The site is bordered by the Missouri River to the south and the Mississippi river to the north and east. These borders are surrounded by a small agricultural levee. The site is bordered by private agricultural lands to the west.

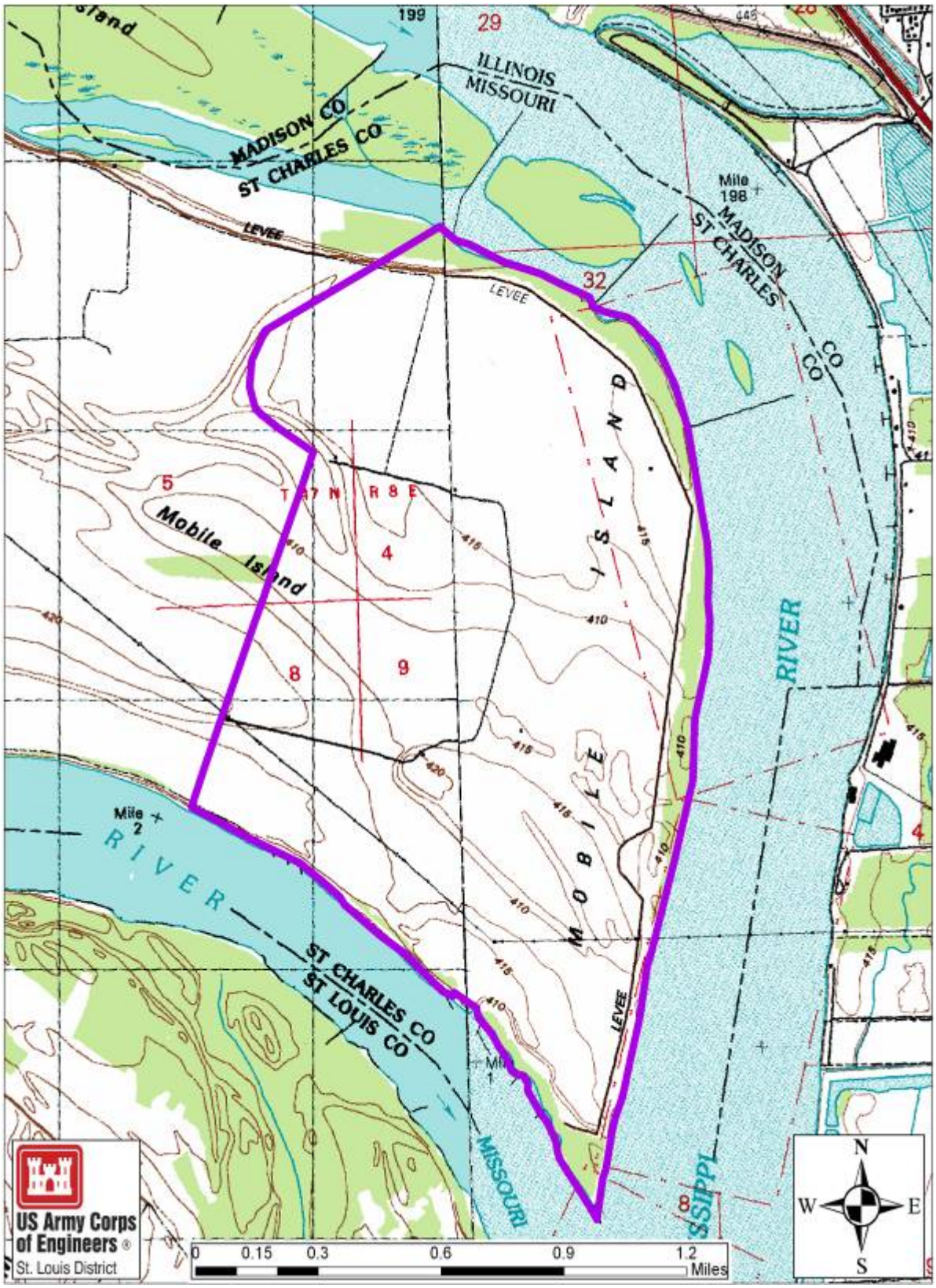


Figure 1. Project Location

The project will consist of series of plantings as well as excavations to create meanders, pools, and mounds to further diversify the areas topography. These excavations will follow and be consistent with the naturally occurring topography on the site. Several berms may be constructed to hold water in shallow pools longer throughout the year. Wetland species will be planted in the lowest, wettest areas. A variety of bottomland forests will also be planted throughout the park. The more water tolerant tree species will be planted in lower elevations with graduations to less water tolerant species in higher elevations. In addition to these plantings natural succession and regeneration of riverfront forest containing primarily cottonwood, silver maple, and willow will be promoted. A large fairly level plain exists in the northern portion of the park and will be planted with wet prairie species. Higher elevations in this plain will be planted with wet mesic prairie species. Portions of the site will remain in cropland in order to serve as sites for planting of native species by environmental education classes in the future. Recreational features will be limited to an additional gravel parking lot. The site will be open to hiking and bird watching.

Threatened and Endangered Species

Information regarding species biology, habitat, and range was gathered from USFWS and publications referenced herein. The information provided through these various sources was assumed to be correct in context and data. No intensive surveys of the project area were conducted. The status, conservation measures, and determination of effect for each species are also summarized in this document. As previously noted, this BA only addresses Federally listed T&E species.

The list of Federal T&E species that are reported to occur in the project area was provided by the USFWS and MDC. The following species were identified:

- Pallid Sturgeon (*Scaphirhynchus albus*)
- Indian Bat (*Myotis sodalis*)
- Decurrent False Aster (*Boltonia decurrens*)

Pallid Sturgeon (*Scaphirhynchus albus*)

The Pallid Sturgeon (*Scaphirhynchus albus*) is a large, wide-ranging benthic fish found throughout the Mississippi River and its major tributaries. The Pallid Sturgeon is adapted to large, free-flowing, turbid rivers with a diverse assemblage of physical characteristics that are in a constant state of change. Pallid Sturgeon have a flattened, shovel-shaped snout; a long, slender, and completely armored caudal peduncle; and they lack a spiracle (USFWS 1993). The mouth is toothless, protrusible, and ventrally positioned under the snout. The principal features distinguishing the Pallid Sturgeon from the shovelnose sturgeon are the paucity of dermal ossifications on the belly, 24 or more anal fin rays, and 37 or more dorsal fin rays (Pflieger 1975). Pallid Sturgeon are known to travel large distances during spawning migrations. Habitat loss through river channelization and dams are two of the major factors responsible for the species decline. The project area includes important habitats for this species, including migration pathways, staging areas,

and habitat for early life stages. Early developmental stages of Pallid Sturgeon spawned upstream potentially drift with the current through the project area. The confluence of the Missouri and Mississippi Rivers has been identified as a priority recovery area because of the high occurrence of Pallids in the area. It is believed that the sturgeon aggregate in the area prior to spawning.

Because the project is being constructed within a leveed area, outside of the river channel, it is not expected to have any impact on the Pallid Sturgeon or its habitat.

Indiana Bat (Myotis sodalis)

The Indiana Bat (Myotis sodalis) spends the winter hibernating in caves in the Ozarks. During April and May, females migrate north and establish small maternity colonies in suitable sites within wooded riparian areas, floodplain forests, or upland forests. Maternity roost sites tend to be in dead or dying trees greater than 9 inches in diameter at breast height and with loose exfoliating bark. Trees most likely to have loose or exfoliating bark are dead oaks, hickories, elms, green and white ash, silver maple, and eastern cottonwood, or living shagbark hickory. Preferred roost sites are located in forest openings, at the forest edge, or where tree canopy is sparse, and within 1 km or water. Indiana Bats forage in and around the tree canopy of floodplain, riparian, and upland forest.

The project will probably have a positive impact on the Indiana Bat. Additional tree plantings will provide possible roosting sites and the creation of wetlands and prairie habitat will increase the foraging areas available to the Indiana Bat. Tree removal is not anticipated so there should not be any loss of roosting sites.

Decurrent False Aster (*Boltonia decurrens*)

The Decurrent False Aster (*Boltonia decurrens*) is presently known from scattered localities on the floodplains of the Illinois River, and Mississippi River from its confluence with the Missouri River south to Madison County, Illinois (USFWS, 1990). Its natural habitat was lake shores and stream banks. It appears to require abundant light. Populations presently grow in natural habitat, but are more common in disturbed lowland areas where they appear to be dependent on human activity for survival (USFWS, 1990).

The Decurrent False Aster currently exists within the project site. The project is expected to have a positive impact on the Decurrent False Aster. The project will convert agricultural lands to habitat types typical of the Decurrent False Aster. The site will be seeded and managed for the plant as well. Construction will seek to avoid areas of the park where populations currently are found.

Conclusion

The T&E species identified in this BA have potential to occur or potential habitat occurs within Confluence Point. The goal of the Mitigation Program, of which Confluence Point is a component, is to restore fish and wildlife habitat along the lower Missouri River. In addition, all project features are designed to enhance, create, or restore terrestrial and aquatic habitat at the Confluence Point. These activities would result in long-term benefits to both of the listed species discussed herein.

References

Pflieger, W.L. 1975. *The Fishes of Missouri*. Missouri Department of Conservation.

U.S. Fish and Wildlife Service (USFWS). 1990. Decurrent False Aster Recovery Plan. Twin Cities, Minnesota: U.S. Fish and Wildlife Service. 26 pp.

U.S. Fish and Wildlife Service (USFWS). 1993. *Pallid sturgeon recovery plan*. U.S. Fish and Wildlife Service, Bismarck, North Dakota.

Appendix F
Environmental Permits and Clearances

The following documents will be included within this appendix: Missouri Department of Natural Resources (MDNR), Water Pollution Control Program, Form E – Application for General Permit (Form E); MDNR, Water Pollution Control Program, Form G – Application for Storm Water Permit Under the General Permit: Land Disturbance (Form G); Storm Water Pollution Prevention Plan (SWPPP); Missouri Emergency Management Agency (SEMA), Engineering "No-Rise" Certification; and the 404 and 401 permit for Nationwide Permit No. 27 Stream and Wetland Restoration Activities.

Section 402 of the Clean Water Act requires that a National Pollutant Discharge Elimination System (NPDES) permit be acquired for discharge of storm water on construction sites that disturb one or more acres of land. The Water Pollution Control Program of the MDNR maintains authority over this permit program for the state of Missouri. The MDNR general permit Form G covers storm water discharges for land disturbances over one acre. MDNR Form E must be submitted concurrently.

MDNR permit requirements include the preparation of a SWPPP. The SWPPP is prepared to ensure the design, implementation, management and maintenance of Best Management Practices in order to reduce the amount of sediment and other pollutants in storm water discharges associated with land disturbance activities; comply with the Missouri Water Quality Standards; and ensure compliance with the terms and conditions of the general land disturbance permit.

Section 60.3 (d) (3) of the National Flood Insurance Program (NFIP) regulations states that a community shall "prohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base (100-year) flood discharge." (1995 SEMA; http://www.sema.state.mo.us/) Submittal of the "No Rise" Certification satisfies this requirement.

Appendix G

404 (b)(1) Evaulation

US Army Corps of Engineers

St. Louis District

Section 404 (b)(1) Evaluation (40 CFR 230)

Applicant U.S. Army Corps of Engineers **Applicant Number** _____

Activity Habitat Restoration **Waterway** Missouri River

Section 4, 8, 9 **Township** 47 North **Range** 8 East **County** St. Charles **State** MO

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1. REVIEW OF COMPLIANCE (§230.10[a]-[d]) A review of the permit application indicates that:

	PRELIMINARY [1]		FINAL [2]	
	Yes	**No**	**Yes**	**No**
a. The discharge represents the least environmentally damaging practicable alternative and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to, or be located in, the aquatic ecosystem to fill its basic purpose information gathered for EA alternative (if no, see section 2, and information gathered for EA alternative);	☒	☐ [3]	☐	☐
b. The activity does not appear to (1) violate applicable state water quality standards or effluent standards prohibited under Section 307 of CWA; (2) jeopardize the existence of Federally listed endangered or threatened species or their habitat; and (3) violate requirements of any Federally designated marine sanctuary. (If no, see Section 2b and check responses from resources and water quality certifying agencies);	☒	☐ [3]	☐	☐
c. The activity will not cause or contribute to significant degradation of waters of the United States including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, esthetic, and economic values (if no, see Section 2);	☒	☐ [3]	☐	☐
d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem (If no, see Section 5).	☒	☐ [3]	☐	☐

2. TECHNICAL EVALUATION FACTORS (SUBPARTS C-F)

	ADVERSE EFFECTS				
	N/A	None	Minimal	Substantive	Cumulative
a. Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C)					
1. Substrate impacts	☐	☐	☒	☐	☐
2. Suspended particulates/turbidity impacts	☐	☒	☐	☐	☐
3. Water column impacts	☐	☒	☐	☐	☐
4. Alteration of current patterns and water circulation	☐	☒	☐	☐	☐
5. Alteration of normal water fluctuations/hydroperiod	☐	☒	☐	☐	☐
6. Alteration of salinity gradients	☒	☐	☐	☐	☐
b. Biological Characteristics of the Aquatic Ecosystem (Subpart D)					
1. Effect on threatened/endangered species and their habitat	☐	☒	☐	☐	☐
2. Effect on the aquatic food web	☐	☒	☐	☐	☐
3. Effect on other wildlife (mammals, birds, reptiles, and amphibians)	☐	☒	☐	☐	☐
c. Special Aquatic Sites (Subpart E)					
1. Sanctuaries and refuges	☒	☐	☐	☐	☐
2. Wetlands	☐	☐	☒	☐	☐
3. Mud flats	☒	☐	☐	☐	☐
4. Vegetated shallows	☒	☐	☐	☐	☐
5. Coral reefs	☒	☐	☐	☐	☐
6. Riffle and pool complexes	☒	☐	☐	☐	☐
d. Human Use Characteristics (Subpart F)					
1. Effects on municipal and private water supplies	☐	☒	☐	☐	☐
2. Recreational and commercial fisheries impacts	☐	☒	☐	☐	☐
3. Effects on water-related recreation	☐	☒	☐	☐	☐
4. Esthetic impacts	☐	☒	☐	☐	☐
5. Effects on parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves	☐	☒	☐	☐	☐

REMARKS: Explain on the attached sheet any substantive or cumulative adverse effects.

3. EVALUATION OF DREDGED OR FILL MATERIAL (SUBPART G) [4]

a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material (Check only those appropriate).

1. Physical characteristics ☒
2. Hydrography in relation to known or anticipated sources of contaminants ☒

3. Results from previous testing of the material or similar material in the vicinity of the project..... ☐
4. Known, significant sources of persistent pesticides from land runoff of percolation..... ☐
5. Spill records for petroleum products or designated (Section 311 or CWA) hazardous substances..... ☐
6. Other public records of significant introduction of contaminants from industries, municipalities, or other sources ..... ☐
7. Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities..... ☐
8. Other sources (specify)..... ☐

List appropriate references (see attached sheet).

b. Testing Exclusion: An evaluation of the appropriate information in 3a above indicates that the proposed discharge material meets testing exclusion criteria for the following reason: **Yes** ☒ **No** ☐ [3]

1. Based on the information above, there is reason to believe the proposed dredge or fill material is not a carrier of contaminants..... ☒
2. The levels of contaminants are substantially similar at the extraction and disposal sites and not likely to result in degradation of the disposal site, and pollutants will not be transported to less contaminated areas; and/or..... ☐
3. Acceptable constraints are available and will be implemented to reduce contamination to acceptable levels within the disposal site and to prevent contaminants from being transported beyond the boundaries of the disposal site..... ☐

4. DISPOSAL SITE DELINEATION (§230.11[f])

a. The following factors, as appropriate, have been considered in evaluating the disposal site.

1. Depth of water at disposal site..... ☒
2. Current velocity, direction, and variability at disposal site..... ☐
3. Degree of turbulence..... ☐
4. Water column stratification ..... ☐
5. Discharge vessel speed and direction..... ☐
6. Rate of discharge..... ☐
7. Dredged material characteristics (constituents, amount and type of material, settling velocities)..... ☒
8. Number of discharges per unit of time..... ☐
9. Other factors affecting rates and patterns of mixing (specify)..... ☐

List appropriate references on attached sheet.

b. Mixing Zone Determination: An evaluation of the appropriate factors in 4a above indicates that the disposal site and/or size of mixing zone are acceptable..... **Yes** ☒ **No** ☐

5. ACTIONS TO MINIMIZE ADVERSE EFFECTS (SUBPART H) All appropriate and practicable steps, as warranted, have been taken through application of recommendations of §230.70-230.77 to insure minimal adverse effects of the proposed discharge. **List Actions Taken (see attached sheet)**..... ☒ ☐

RETURN TO SECTION 1 FOR FINAL COMPLIANCE REVIEW.

6. FACTUAL DETERMINATIONS (§230.11)

A review of the appropriate information as identified in items 2-5 above indicates that there is minimal potential for short-term or long-term environmental effects of the proposed discharge as related to:

	Yes	No
a. Physical substrate at the disposal site (review sections 2a, 3, 4, and 5).....	☒	☐
b. Water circulation, fluctuation, and salinity (review sections 2a, 3, 4, and 5).....	☒	☐
c. Suspended particulates/turbidity (review sections 2a, 3, 4, and 5).....	☒	☐
d. Contaminant availability (review sections 2a, 3, and 4).....	☒	☐
e. Aquatic ecosystem structure and function (review sections 2b and c, 3 and 5).....	☒	☐
f. Disposal site (review sections 2, 4, and 5).....	☒	☐
g. Cumulative impact on the aquatic ecosystem.....	☒	☐
h. Secondary impacts on the aquatic ecosystem.....	☒	☐

7. EVALUATION RESPONSIBILITY

a. This evaluation was prepared by: _____ Date: _____

Position: _____

b. This evaluation was reviewed by: _____ Date: _____

Position: _____

8. FINDINGS

a. The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines..... ☐
b. The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines with the inclusion of the following conditions (see attached sheet)..... ☒
c. The proposed disposal site for discharge of dredged or fill material does not comply with the Section 404(b)(1) guidelines

for the following reason(s):

1. There is a less damaging practicable alternative…… ☐
2. The proposed discharge will result in significant degradation of the aquatic ecosystem…… ☐
3. The proposed discharge does not include all practicable and appropriate measures to minimize potential harm to the aquatic ecosystem …… ☐

Signature_____ Date _____

Danny McClendon, Corps of Engineers
Regulatory Branch Chief

By_____

[1] A negative, significant. or unknown response indicates that the permit application may not be in compliance with the Section 404(b)(1) Guidelines.

[2] Negative responses to three or more of the compliance criteria at this stage indicates that the proposed projects may not be evaluated using this "short-form procedures." Care should be used in assessing pertinent portions of the technical information of items 2 a-d below, before completing the final review of compliance.

[3] Negative responses to one of the compliance criteria at this stage indicate that the proposed project does not comply with the guidelines. If the economics of navigation and anchorage of Section 404(b)(2) are to be evaluated in the decision-making process, the "short -form" evaluation process if inappropriate.

[4] If the dredged or fill material cannot be excluded from individual testing, the "short-form" evaluation process if inappropriate.

Section 404 (b)(1) Evaluation (40 CFR 230)
Attachment Page

References:

☐ Application File Number (RAMS)_____

☒ U.S. Geological Survey Maps

☐ U.S. Geological Survey Water Resources Data

☐ U.S. Environmental Protection Agency Fish Kill Data

☐ Missouri Department of Conservation Fish Kill Data

☐ U.S. Environmental Protection Agency Inquiry / Data / Administrative Notice

☐ U.S. Environmental Protection Agency Water Quality Data

☒ Other: ___ NRCS EDWARD (TED) AND PAT JONES STATE PARK SOILS REPORT (2006) found in Appendix B of Confluence Point Project Implementation Report (Corps, 2009). _____
___ HTRW Initial Hazrd Assessment Phase I Environmental Site Assessment of Confluence Point State Park Ecosystem Restoration (2008)

PRELIMINARY EVALUATION: Fill is being used to create small berms that would function to enhance wetland areas on the site. Minimal impacts to substrate, suspended particulates/turbidity, and the water column are explained in Chapter 4 of the Confluence Point Project Implementation Report (Corps, 2009).

Nationwide Permit Summary

U.S Army Corps
Of Engineers
St. Louis District

No. 27, AQUATIC HABITAT RESTORATION, ESTABLISHMENT, AND ENHANCEMENT ACTIVITIES
(NWP Final Notice, 72 FR 11185)

Activities in waters of the United States associated with the restoration, enhancement, and establishment of tidal and non-tidal wetlands and riparian areas and the restoration and enhancement of non-tidal streams and other non-tidal open waters, provided those activities result in net increases in aquatic resource functions and services.

To the extent that a Corps permit is required, activities authorized by this NWP include, but are not limited to: the removal of accumulated sediments; the installation, removal, and maintenance of small water control structures, dikes, and berms; the installation of current deflectors; the enhancement, restoration, or establishment of riffle and pool stream structure; the placement of in-stream habitat structures; modifications of the stream bed and/or banks to restore or establish stream meanders; the backfilling of artificial channels and drainage ditches; the removal of existing drainage structures; the construction of small nesting islands; the construction of open water areas; the construction of oyster habitat over unvegetated bottom in tidal waters; shellfish seeding; activities needed to reestablish vegetation, including plowing or discing for seed bed preparation and the planting of appropriate wetland species; mechanized land clearing to remove non-native invasive, exotic, or nuisance vegetation; and other related activities. Only native plant species should be planted at the site.

This NWP authorizes the relocation of non-tidal waters, including non-tidal wetlands and streams, on the project site provided there are net increases in aquatic resource functions and services.

Except for the relocation of non-tidal waters on the project site, this NWP does not authorize the conversion of a stream or natural wetlands to another aquatic habitat type (e.g., stream to wetland or vice versa) or uplands. This NWP does not authorize stream channelization. This NWP does not authorize the relocation of tidal waters or the conversion of tidal waters, including tidal wetlands, to other aquatic uses, such as the conversion of tidal wetlands into open water impoundments.

Reversion. For enhancement, restoration, and establishment activities conducted: (1) In accordance with the terms and conditions of a binding wetland enhancement, restoration, or establishment agreement between the landowner and the U.S. Fish and Wildlife Service (FWS), the Natural Resources Conservation Service (NRCS), the Farm Service Agency (FSA), the National Marine Fisheries Service (NMFS), the National Ocean Service (NOS), or their designated state cooperating agencies; (2) as voluntary wetland restoration, enhancement, and establishment actions documented by the NRCS or USDA Technical Service Provider pursuant to NRCS Field Office Technical Guide standards; or (3) on reclaimed surface coal mine lands, in accordance with a Surface Mining Control and Reclamation Act permit issued by the OSM or the applicable state agency, this NWP also authorizes any future discharge of dredged or fill material associated with the reversion of the area to its documented prior condition and use (i.e., prior to the restoration, enhancement, or establishment activities). The reversion must occur within five years after expiration of a limited term wetland restoration or establishment agreement or permit, and is authorized in these circumstances even if the discharge occurs after this NWP expires. The five-year reversion limit does not apply to agreements without time limits reached between the landowner and the FWS, NRCS, FSA, NMFS, NOS, or an appropriate state cooperating agency. This NWP also authorizes discharges of dredged or fill material in waters of the United States for the reversion of wetlands that were restored, enhanced, or established on prior-converted cropland that has not been abandoned or on uplands, in accordance with a binding agreement between the landowner and NRCS, FSA, FWS, or their designated state cooperating agencies (even though the restoration, enhancement, or establishment activity did not require a section 404 permit). The prior condition will be documented in the original agreement or permit, and the determination of return to prior conditions will be made by the Federal agency or appropriate state agency executing the agreement or permit. Before conducting any reversion activity the permittee or the appropriate Federal or state agency must notify the district engineer and include the documentation of the prior condition. Once an area has reverted to its prior physical condition, it will be subject to whatever the Corps Regulatory requirements are applicable to that type of land at the time. The requirement that the activity result in a net increase in aquatic resource functions and services does not apply to reversion activities meeting the above conditions. Except for the activities described above, this NWP does not authorize any future discharge of dredged or fill material associated with the reversion of the area to its prior condition. In such cases a separate permit would be required for any reversion.

Reporting: For those activities that do not require pre-construction notification, the permittee must submit to the district engineer a copy of: (1) The binding wetland enhancement, restoration, or establishment agreement, or a project description, including project plans and location map; (2) the NRCS or USDA Technical Service Provider documentation for the voluntary wetland restoration, enhancement, or establishment action; or (3) the SMCRA permit issued by OSM or the applicable state agency. These documents must be submitted to the district engineer at

least 30 days prior to commencing activities in waters of the United States authorized by this NWP.

Notification. The permittee must submit a pre-construction notification to the district engineer prior to commencing the activity (see general condition 27), except for the following activities:

(1) Activities conducted on non-Federal public lands and private lands, in accordance with the terms and conditions of a binding wetland enhancement, restoration, or establishment agreement between the landowner and the U.S. FWS, NRCS, FSA, NMFS, NOS, or their designated state cooperating agencies;

(2) Voluntary wetland restoration, enhancement, and establishment actions documented by the NRCS or USDA Technical Service Provider pursuant to NRCS Field Office Technical Guide standards; or

(3) The reclamation of surface coal mine lands, in accordance with an SMCRA permit issued by the OSM or the applicable state agency.

However, the permittee must submit a copy of the appropriate documentation. (Sections 10 and 404)

Note: This NWP can be used to authorize compensatory mitigation projects, including mitigation banks and in-lieu fee programs. However, this NWP does not authorize the reversion of an area used for a compensatory mitigation project to its prior condition, since compensatory mitigation is generally intended to be permanent.

NATIONWIDE PERMIT CONDITIONS

General Conditions: Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as appropriate, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP

1. **Navigation**. (a) No activity may cause more than a minimal adverse effect on navigation.

(b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.

(c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. **Aquatic Life Movements**. No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. Culverts placed in streams must be installed to maintain low flow conditions.

3. **Spawning Areas**. Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. **Migratory Bird Breeding Areas**. Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. **Shellfish Beds**. No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48.

6. **Suitable Material**. No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. **Water Supply Intakes**. No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. **Adverse Effects From Impoundments**. If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. **Management of Water Flows**. To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. **Fills Within 100-Year Floodplains**. The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. **Equipment**. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. **Soil Erosion and Sediment Controls**. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

13. **Removal of Temporary Fills**. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. **Proper Maintenance**. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety.

15. **Wild and Scenic Rivers**. No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a “study river” for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency in the area (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

16. **Tribal Rights**. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

17. **Endangered Species**. (a) No activity is authorized under any NWP which is likely to jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.

(b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements.

(c) Non-federal permittees shall notify the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that may be affected by the proposed work or that utilize the designated critical habitat that may be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed.

(d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs.

(e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the U.S. FWS or the NMFS, both lethal and non-lethal "takes" of protected species are in violation of the ESA. Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their world wide Web pages at http://www.fws.gov/ and http://www.noaa.gov/fisheries.html respectively.

18. **Historic Properties**. (a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

(b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties which the activity may have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

(d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required.

19. **Designated Critical Resource Waters**. Critical resource waters include, NOAA-designated marine sanctuaries, National Estuarine Research Reserves, state natural heritage sites, and outstanding national resource waters or other waters officially designated by a state as having particular environmental or ecological significance and identified by the district engineer after notice and opportunity for public comment. The district engineer may also designate additional critical resource waters after notice and opportunity for comment.

(a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, and 50 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

(b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 27, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

20. **Mitigation**. The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal:

(a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10 acre and require pre-construction notification, unless the district engineer determines in writing that some other form of mitigation would be more environmentally appropriate and provides a project-specific waiver of this requirement. For wetland losses of 1/10 acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

(d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream restoration, to ensure that the activity results in minimal adverse effects on the aquatic environment.

(e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2 acre, it cannot be used to authorize any project resulting in the loss of greater than1/2 acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

(f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(g) Permittees may propose the use of mitigation banks, in-lieu fee arrangements or separate activity-specific compensatory mitigation. In all cases, the mitigation provisions will specify the party responsible for accomplishing and/or complying with the mitigation plan.

(h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

21. **Water Quality**. Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

22. **Coastal Zone Management**. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

23. **Regional and Case-By-Case Conditions**. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

24. **Use of Multiple Nationwide Permits**. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

25. **Transfer of Nationwide Permit Verifications**. If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature: “When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.”

26. **Compliance Certification**. Each permittee who received an NWP verification from the Corps must submit a signed certification regarding the completed work and any required mitigation. The certification form must be forwarded by the Corps with the NWP verification letter and will include:

(a) A statement that the authorized work was done in accordance with the NWP authorization, including any general or specific conditions;

(b) A statement that any required mitigation was completed in accordance with the permit conditions; and

(c) The signature of the permittee certifying the completion of the work and mitigation.

27. **Pre-Construction Notification**. (a) Timing. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, as a general rule, will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:

(1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or

(2) Forty-five calendar days have passed from the district engineer’s receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 17 that listed species or critical habitat might affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 18 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that is “no effect” on listed species or “no potential to cause effects” on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) is completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee cannot begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee’s right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) Contents of Pre-Construction Notification: The PCN must be in writing and include the following information:

(1) Name, address and telephone numbers of the prospective permittee;

(2) Location of the proposed project;

(3) A description of the proposed project; the project’s purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided result in a quicker decision.);

(4) The PCN must include a delineation of special aquatic sites and other waters of the United States on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic

sites and other waters of the United States, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the United States. Furthermore, the 45 day period will not start until the delineation has been submitted to or completed by the Corps, where appropriate;

(5) If the proposed activity will result in the loss of greater than 1/10 acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

(6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and

(7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.

(c) Form of Pre-Construction Notification: The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used.

(d) Agency Coordination: (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.

(2) For all NWP 48 activities requiring pre-construction notification and for other NWP activities requiring pre-construction notification to the district engineer that result in the loss of greater than 1/2-acre of waters of the United States, the district engineer will immediately provide (e.g., via facsimile transmission, overnight mail, or other expeditious manner) a copy of the PCN to the appropriate Federal or state offices (U.S. FWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will then have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame, but will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(4) Applicants are encouraged to provide the Corps multiple copies of pre-construction notifications to expedite agency coordination.

(5) For NWP 48 activities that require reporting, the district engineer will provide a copy of each report within 10 calendar days of receipt to the appropriate regional office of the NMFS.

(e) District Engineer's Decision: In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. If the proposed activity requires a PCN and will result in a loss of greater than 1/10 acre of wetlands, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for projects with smaller impacts. The district engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed work are minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the district engineer will notify the permittee and include any conditions the district engineer deems necessary. The district engineer must approve any compensatory mitigation proposal before the permittee commences work. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are determined by the district engineer to be minimal, the district engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP. If the district engineer determines that the adverse effects of the proposed work are more than minimal, then the district engineer will notify the applicant either: (1) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit; (2) that the project is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level; or (3) that the project is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period. The authorization will include the necessary conceptual or specific mitigation or a requirement that the applicant submit a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level. When mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan.

28. **Single and Complete Project**. The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

FURTHER INFORMATION

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.
2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.
3. NWPs do not grant any property rights or exclusive privileges.
4. NWPs do not authorize any injury to the property or rights of others.
5. NWPs do not authorize interference with any existing or proposed Federal project.

DEFINITIONS

Best management practices (BMPs): Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Compensatory mitigation: The restoration, establishment (creation), enhancement, or preservation of aquatic resources for the purpose of compensating for unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Currently serviceable: Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

Discharge: The term "discharge" means any discharge of dredged or fill material.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Ephemeral stream: An ephemeral stream has flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

Establishment (creation): The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area.

Historic Property: Any prehistoric or historic district, site (including archaeological site), building, structure, or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

Independent utility: A test to determine what constitutes a single and complete project in the Corps regulatory program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Intermittent stream: An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

Loss of waters of the United States: Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the United States is a threshold measurement of the impact to jurisdictional waters for determining whether a project may qualify for an NWP; it is not a net threshold that is calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and services. The loss of stream bed includes the linear feet of stream bed that is filled or excavated. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. Impacts resulting from activities eligible for exemptions under Section 404(f) of the Clean Water Act are not considered when calculating the loss of waters of the United States.

Non-tidal wetland: A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. The definition of a wetland can be found at 33 CFR 328.3(b). Non-tidal wetlands contiguous to tidal waters are located landward of the high tide line (i.e., spring high tide line).

Open water: For purposes of the NWPs, an open water is any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of standing or flowing water is either non-emergent, sparse, or absent. Vegetated shallows are considered to be open waters. Examples of "open waters" include rivers, streams, lakes, and ponds.

Ordinary High Water Mark: An ordinary high water mark is a line on the shore established by the fluctuations of water and indicated by physical characteristics, or by other appropriate means that consider the characteristics of the surrounding areas (see 33 CFR 328.3(e)).

Perennial stream: A perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

Practicable: Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Pre-construction notification: A request submitted by the project proponent to the Corps for confirmation that a particular activity is authorized by nationwide permit. The request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Pre-construction notification may be required by the terms and conditions of a nationwide permit, or by regional conditions. A pre-construction notification may be voluntarily submitted in cases where pre-construction notification is not required and the project proponent wants confirmation that the activity is authorized by nationwide permit.

Preservation: The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: re-establishment and rehabilitation.

Riffle and pool complex: Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

Riparian areas: Riparian areas are lands adjacent to streams, lakes, and estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects waterbodies with their adjacent uplands. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. (See general condition 20.)

Shellfish seeding: The placement of shellfish seed and/or suitable substrate to increase shellfish production. Shellfish seed consists of immature individual shellfish or individual shellfish attached to shells or shell fragments (i.e., spat on shell). Suitable substrate may consist of shellfish shells, shell fragments, or other appropriate materials placed into waters for shellfish habitat.

Single and complete project: The term "single and complete project" is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete project must have independent utility (see definition). For linear projects, a "single and complete project" is all crossings of a single water of the United States (i.e., a single waterbody)

at a specific location. For linear projects crossing a single waterbody several times at separate and distant locations, each crossing is considered a single and complete project. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

Stormwater management: Stormwater management is the mechanism for controlling stormwater runoff for the purposes of reducing downstream erosion, water quality degradation, and flooding and mitigating the adverse effects of changes in land use on the aquatic environment.

Stormwater management facilities: Stormwater management facilities are those facilities, including but not limited to, stormwater retention and detention ponds and best management practices, which retain water for a period of time to control runoff and/or improve the quality (i.e., by reducing the concentration of nutrients, sediments, hazardous substances and other pollutants) of stormwater runoff.

Stream bed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the stream bed, but outside of the ordinary high water marks, are not considered part of the stream bed.

Stream channelization: The manipulation of a stream's course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized stream remains a water of the United States.

Structure: An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

Tidal wetland: A tidal wetland is a wetland (i.e., water of the United States) that is inundated by tidal waters. The definitions of a wetland and tidal waters can be found at 33 CFR 328.3(b) and 33 CFR 328.3(f), respectively. Tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by other waters, wind, or other effects. Tidal wetlands are located channelward of the high tide line, which is defined at 33 CFR 328.3(d).

Vegetated shallows: Vegetated shallows are special aquatic sites under the 404(b)(1) Guidelines. They are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as seagrasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems.

Waterbody: For purposes of the NWPs, a waterbody is a jurisdictional water of the United States that, during a year with normal patterns of precipitation, has water flowing or standing above ground to the extent that an ordinary high water mark (OHWM) or other indicators of jurisdiction can be determined, as well as any wetland area (see 33 CFR 328.3(b)). If a jurisdictional wetland is adjacent--meaning bordering, contiguous, or neighboring--to a jurisdictional waterbody displaying an OHWM or other indicators of jurisdiction, that waterbody and its adjacent wetlands are considered together as a single aquatic unit (see 33 CFR 328.4(c)(2)). Examples of "waterbodies" include streams, rivers, lakes, ponds, and wetlands.

Missouri
Department of
Natural Resources

WATER PROTECTION PROGRAM Missouri General Water Quality Certification Conditions for NWP 27 (Aquatic Habitat Restoration, Establishment, and Enhancement Activities)

Pursuant to Section 401 of the Clean Water Act of 1972 the following best management practices are included as conditions in Section 404 of the U.S. Army Corps of Engineers' (Corps) Nationwide Permit (NWP). These conditions ensure that maintenance activities do not violate the Water Quality Standards of the State of Missouri resulting in permanent damage to habitat, increased turbidity, reduced bank and channel stability, and impacts to the biological and chemical integrity of the water body. Jurisdictional definitions for this activity are explained in the NWP.

1. NWPs shall not allow the filling of jurisdictional springs.

2. Acquisition of a NWP(s) and attendant water quality certification(s) shall not be construed or interpreted to imply the requirements for other permits are replaced or superceded. Any National Pollutant Discharge Elimination System (NPDES) Permits, Land Disturbance General Permits, or other requirements shall be complied with. Applicants with questions are encouraged to call the Water Protection Program, NPDES Permits and Engineering Section, at (573) 526¬3589.

3. Care shall be taken to keep machinery out of the waterway as much as possible. Fuel, oil and other petroleum products, equipment and any solid waste shall not be stored below the ordinary high water mark at any time or in the adjacent floodway beyond normal working hours. All precautions shall be taken to avoid the release of wastes or fuel to streams and other adjacent water bodies as a result of this operation.

4. Petroleum products spilled into any water body or on the banks where the material may enter waters of the state shall be immediately cleaned up and disposed of properly. Any such spills of petroleum shall be reported as soon as possible to the Missouri Department of Natural Resources' 24¬hour Environmental Emergency Response number at (573) 634¬2436.

5. Only clean, nonpolluting fill shall be used. The following materials are not suitable for bank stabilization and shall not be used due to their potential to cause violations of the general criteria of the Water Quality Standards, 10 CSR 20¬7.031 (A) – (H):

Earthen fill, gravel, broken concrete where the material does not meet the specifications outlined below, and fragmented asphalt, since these materials are usually not substantial enough to withstand erosive flows; Concrete with exposed rebar; Tires, vehicles or vehicle bodies, construction or demolition debris are solid waste and are excluded from placement in the waters of the state; Liquid concrete, including grouted riprap, if not placed as part of an engineered structure; and Any material containing chemical pollutants (for example: creosote or pentachlorophenol).

Approved May 2007

Recycled or broken concrete may be used provided that it is reasonably well graded, consisting of pieces varying in size from 20 pounds up to and including at least 150 pound pieces. Applicants must break all large slabs to conform to the well¬graded requirement. Generally, the maximum weight of any piece shall not be more than 500 pounds. Gravel and dirt shall not exceed 15 percent of the total fill volume. All protruding reinforcement rods, trash, asphalt and other extraneous materials must be removed from the broken concrete prior to placement.

Recycled or broken concrete being used simply as fill need not conform to the well¬graded requirement. It shall, however, be free of extraneous materials and shall be placed to eliminate voids within the fill.

6. Clearing of vegetation/trees shall be the minimum necessary to accomplish the activity. A vegetated corridor shall be maintained from the high bank on either side of the jurisdictional channel to protect water quality and to provide for long¬term stability of the stream channel, unless physical barriers prevent such a corridor. For purposes of this NWP, lack of ownership or control of any portion of this corridor may be considered a legitimate and discretionary cause to waive this requirement on that portion.

7. This water quality certification is not valid for any Section 404 permit issued on a water body that:

Is listed as impaired pursuant to Section 303(d) of the Clean Water Act; If the activities are located in or occur within two miles upstream of a designated outstanding state or national resource area (10 CSR 20¬7.031); or If the activities are located in a designated metropolitan no¬discharge stream.

8. Streambed gradient shall not be permanently altered during project construction.

9. NWPs involving a loss of more than 1/10 acre of wetlands with a predominance of bottomland hardwoods that are comprised mainly of different species of gum, oak and bald cypress shall require individual water quality certification by the state.

10. NWPs issued by the Corps for which the 300 linear feet threshold for stream impacts is waived by the district engineer on classified water bodies as defined by 10 CSR 20¬7.031 shall require individual water quality certification by the state.

11. No project under a NWP shall accelerate bed or bank erosion.

12. Planting of any required vegetated buffer shall maximize the use of native, flood tolerant species to provide soil stabilization and wildlife benefits. Invasive, non¬native species are prohibited.

13. Pursuant to Chapter 644.038, RSMo, the department certifies all NWPs for impacts in all waters of the state without the above¬stated or any other conditions for the construction of

highways and bridges approved by the Missouri Highway and Transportation Commission.